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SURVEYING AND MAPPING is the official journal of the Congress and is published quarterly during the months of March, June, September, and December. The Congress welcomes articles and interesting news items for publication in its journal. Manuscripts should be sent to the Chairman of the Publications Committee.

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SURVEYING AND MAPPING is published quarterly by the AMERICAN CONGRESS ON SURVEYING AND MAPPING, Box 470, Benjamin Franklin Station, Washington 4, D. C. Yearly subscriptions to non-members: U. S. $5.00; foreign $6.00. Single copies $1.50 plus postage.

Entered as second-class matter at the Post Office at Washington, D. C., November 13, 1944, under the Act of March 3, 1879. Additional entry as second-class matter at the Post Office at Lancaster, Pa.

SURVEYING AND MAPPING

Editor-in-Chief
Howard S. Rappleye,

A QUARTERLY JOURNAL
DEVOTED TO THE ADVANCEMENT OF THE SCIENCES
OF SURVEYING AND MAPPING

Volume XV, No. 4
October–December 1955

PUBLISHED BY THE
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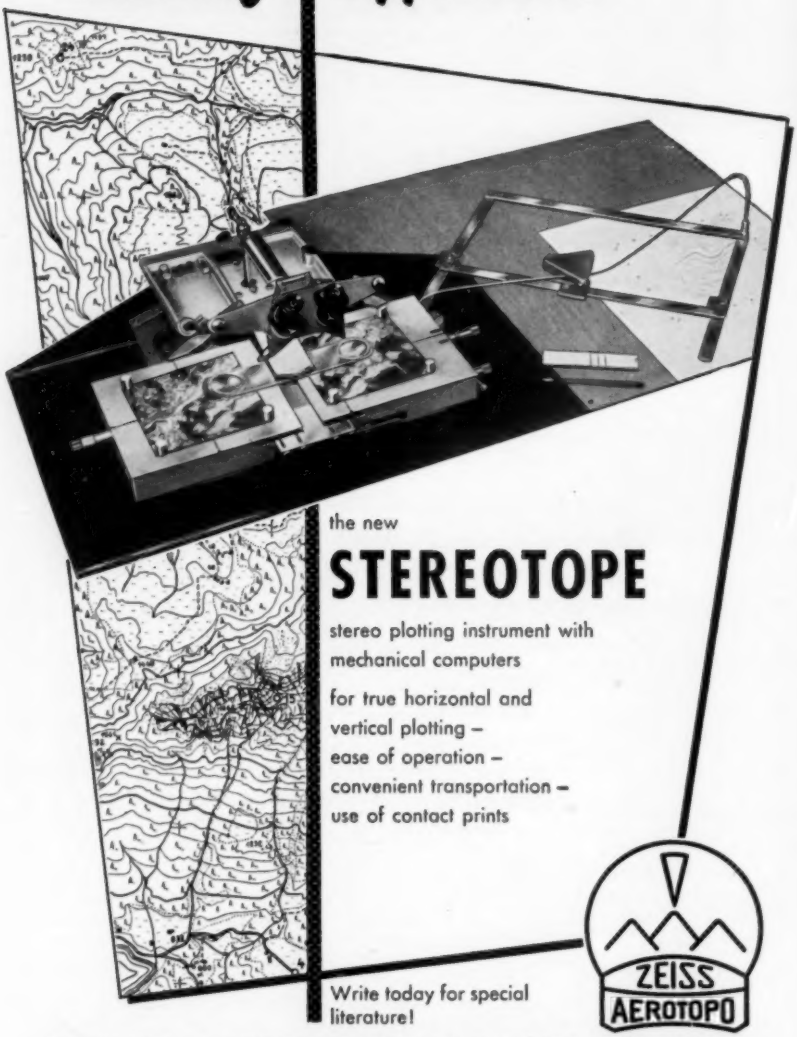

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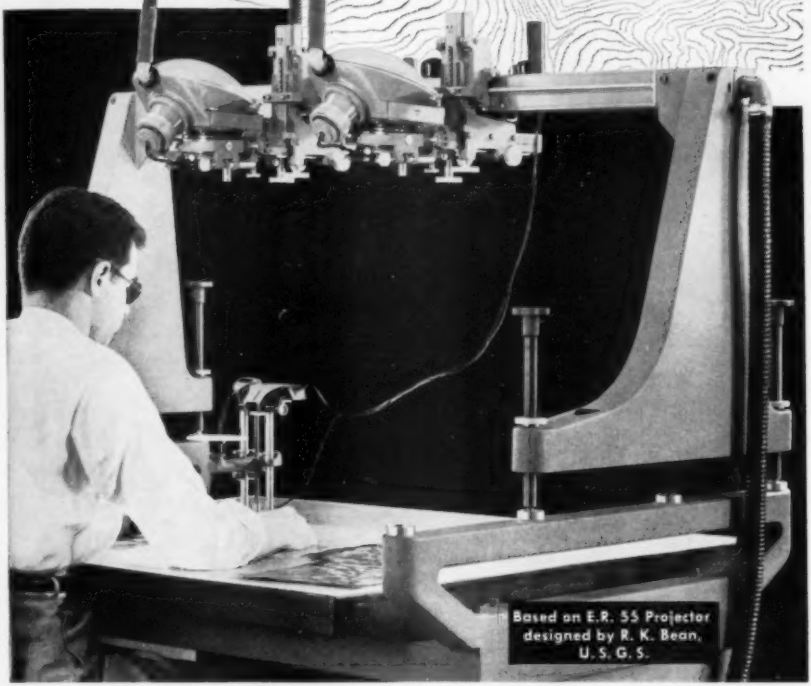

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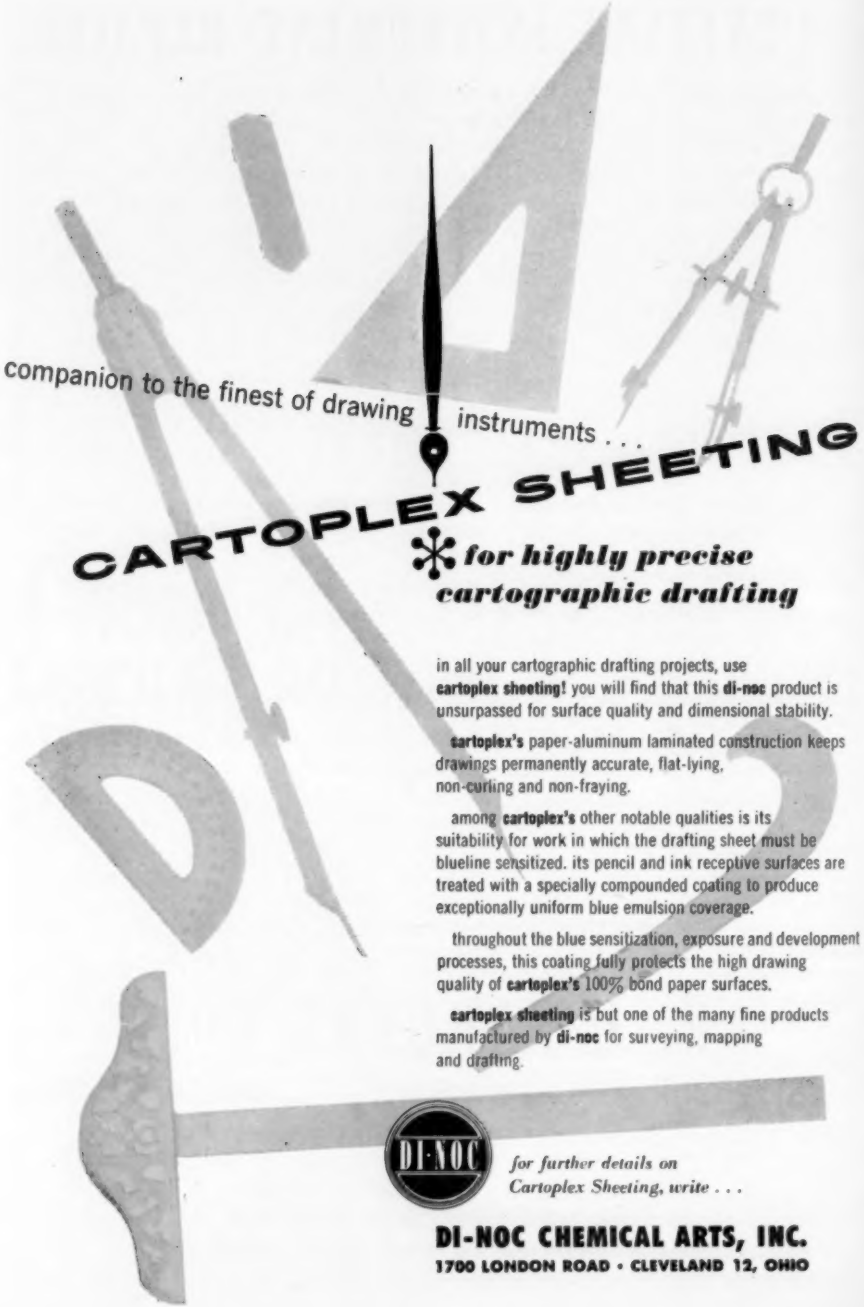

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PROGRAM PREVIEW—the coming March annual meetings

1956 ACSM–ASP Consecutive Meetings and Co-Exhibit

March 18–24, 1956, Shoreham Hotel, Washington, D. C.

Sessions of American Congress on Surveying and Mapping—Monday, Tuesday, Wednesday morning

Sessions of American Society of Photogrammetry—Wednesday afternoon, Thursday, Friday

ACSM PROGRAM: Reflecting the broad objectives of ACSM in the public interest and in the technical and professional scope of its membership, the 16th Annual Program of American Congress on Surveying and Mapping includes programs of its six Divisions in the general plenary sessions. ACSM will program key speakers, panels, and papers by leaders in their fields. ACSM Divisions, already well under way, program as follows: The Cartography Division presents "World Mapping" by an outstanding speaker pointing out the great need for map and chart coverage here and abroad, a subject of great importance. Another subject is entitled "Dimensional Stability Tests of Cartographic Materials," of interest not only to cartographers but others concerned with exactness-of-scale and registry problems in producing maps or charts or scale drawings. Control Surveys Division schedules papers on modern automatic computing, the availability of survey control data, and a review of the present progress of the revised specifications for control surveys. Education Division agenda is "Professional Status of Surveying and Mapping," and "Reaction of Recent Developments in the Schools in regard to Surveying Courses." Instruments Division, already strongly behind the scenes of the Co-Exhibit, as usual will come up with a lively topic or two. Property Surveys Division is programming the famed Jesuit Explorer, Father Linehan, with an illustrated lecture, "Surveying in Polar Regions." Also, "Down East Survey Problems with Tidal Lands," experience from the Maine coast. Another feature will be "Computations for Subdivisions," by Harold Welch, of Colorado, California, and Labrador. Also some salient points in Quebec surveying, by a Canadian expert. Topography Division features "Surveying and Mapping of Antarctica" in plenary forum discussion by an expert panel. That vast continent of practically unexplored terrain is ever increasingly of timely interest as zero hour for Operation "Deep Freeze" approaches. Contours for land-subsidence studies and the use of the planetable by land surveyors—while on the site—to make planimetric or topographic plots, are other likely topics. Recent recurring devastation by storm-water flood damage in the northeastern sections of the United States has also suggested the topic of "Importance of adequate comprehensive surveys and maps in flood-control studies."

ASP PROGRAM: The technical program for the 22nd Annual Meeting of the American Society of Photogrammetry is being designed to satisfy the diversified interests of its many members. Thus there will be papers on almost every phase of photogrammetric activity. In particular, panels are being organized on aerial photography, photogeology, and photo interpretation, to be moderated by William E. Harman, Jr., William A. Fischer, and Donald J. Belcher respectively, each of whom is a noted authority in his field. The subject matter of the aerial-photography panel will consider the latest developments concerning the photographic airplane, camera mounts, the effects of haze, modern processing equipment, color, and the amount of imagery which can be detected from photographs taken at various altitudes. The photogeology panel will include papers on the application of stereoplotting equipment to geologic mapping, the application of color photography to geologic studies, the training of photogeologists, and the role of photogeology in an over-all exploration program. The photointerpretation panel will, as in previous years, cover the important phases of and latest developments in photointerpretation work. Particular emphasis will be placed on panel discussion and questions from the audience.

Other speakers will talk on automatic contouring, photogrammetric scribing, the use of the variable-ratio pantograph, Navy photo-evaluation teams, supplemental control by phototheodolite, new techniques for making three-dimensional models, the role of automation in photogrammetry, and a host of other subjects for which arrangements are now being made.

EXHIBIT: The ACSM-ASP Co-Exhibit has every indication of surpassing last meetings' exposition which ranked with the greatest of its kind ever assembled.

SOCIAL FUNCTIONS: ACSM-ASP social co-activities include a cocktail social, a grand banquet, a dance, and, for the ladies, a tea, sightseeing, and special events.

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1956 ACSM-ASP Consecutive Meetings and Co-Exhibit

Development of Cartographic and Reproduction Techniques in Chart Production

By COLONEL RICHARD W. PHILBRICK, COMMANDER, AND OTTO C. STOESSEL, JR., CHIEF, REPRODUCTION CHARTING TECHNIQUES OFFICE

AERONAUTICAL CHART AND INFORMATION CENTER

THE METHODOLOGY of solving problems is always fascinating. At the United States Air Force's Aeronautical Chart and Information Center the problem solving cycle is often a tight loop that closes within months, or even weeks. Presented here are three representative problems, with solutions, pertaining to the portrayal and reproduction of aeronautical charts.

VIGNETTING FOR DEPICTING AREAS

The first example considers vignetting as a way of depicting areas on the ACIC jet navigation chart. The JN series are multipurpose charts designed for use as plotting sheets and logs for dead reckoning and celestial navigation. For such usage, solid blue, customarily used to designate open water areas, makes a poor background for plotting and notations, especially when viewed under red light. A clear delimitation of shorelines is particularly desirable as the JN chart serves for radar as well as for visual pilotage. Radar gives strong land-water contrast to and makes no distinction between fresh and briny water. Both come out with the same contrast on the radar screen.

Small bodies of water (lakes, double-line rivers, bays, etc.) need a strong fill to make them stand out adequately. The question of where to change from darker blue to light blue is encountered repeatedly in showing double-line drains which feed into the sea. This question, unfortunately, has no good answer and adds many grey hairs to chart editors.

Presented at the Fifteenth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., March 9–11, 1955.

A standard portrayal that would accent shore lines and automatically give weighted emphasis to smaller water areas according to their dimensions was the desired objective, along with a background of white paper in open water areas. The accompanying illustration (Figure 1) shows the kind of portrayal that was sought. Note how this vignetted representation not only strengthens shorelines but gives extra strength where bodies are of small dimension. This feathered or vignetted shading met all requirements except ease of production.

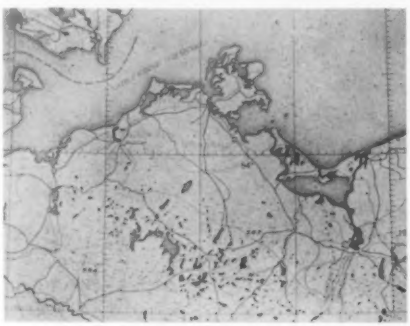


FIGURE 1.

As hand and airbrush samples were prepared we became appalled at the amounts of skilled judgment, artistry, and man-hours that were required. We noted that early cartographers had solved similar problems. DeWit, on charts at a similar scale prepared around 1688, used vignetted or feather-edged open water areas. He also used this convention for lakes and found that standard vignetting gave added emphasis to smaller water bodies.

In seventeenth-century Holland, however, cartographic artistry was no critical commodity and the man-hour unit had probably not been conceived. Labor costs and man-hours are more significant factors in twentieth-century America. It was, therefore, a pleasant surprise when our reproduction techniques branch devised a photomechanical solution that called for almost no hand labor.

Figure 1 is representative of the vignetting that is achieved by the new process. The technique is quick and inexpensive, and it gives consistent rendition. It has already been adopted for portrayal of water areas on jet navigation charts by the RAF and by the United States Air Force. The same basic technique is now being adapted at ACIC for depicting wooded areas. In fact, the technique shows promise in the representation of any area where featheredge enhancement is a factor.

Photochemical vignetting, as the name implies, products a vignette tone around and within given outlines by a photomechanical procedure. The operation is based on light migration, so a given circumstance will give consistent and uniform results. Materials necessary to achieve photomechanical vignettes include the object to be vignetted or the original drawing (open window) of the areas where vignette is desired.

For the water-tint vignette, the original open window negative is used to obtain a positive reduction to the desired size. The line reduction of the original open window negative is first made by conventional process camera operation. The original is reduced for several reasons. First, a good many of the finished charts are larger than the magenta contact screen by which the vignette is obtained. Second, reduction is used for partial control of the vignette band width. Because an enlargement of the final vignette is necessary to bring the finished product to the original size, this can be a controlling factor for the width of the vignette band. After the image reduction is made, the reduced positive is made ready for the actual vignette operation by detailed opaquing. This is an essential step since undesirable pin holes appearing in the reduced positive will form unwanted vignette; while deemphasized or lost detail will not give the desired vignette.

After the opaquing operation is completed, the vignette procedure is started. This consists of making a composite sandwich exposure by utilizing the theory of light dispersion. The sandwich is prepared as follows. A sheet of photosensitized litho film is placed in position at the bottom. Over this unexposed film, a magenta contact screen is positioned. This screen permits making a direct halftone of the selected vignetted area. Since the ability to obtain a good halftone negative from the original artist's drawing is difficult and inconsistent, the direct halftone medium is a vital step.

Positioned over the screen are the dispersion materials which accomplish the degree of light migration desired. Satisfactory for this operation are any of the many types of plastics, grained on one or two sides, and either frosted or opaque white. For greater vignette bands opal glass of various thicknesses and dispersion qualities can be utilized. When a reduced positive is utilized, a relatively small vignette is adequate because of the subsequent enlargment steps which are required to bring the original band to proper scale. A sheet of grained vinyl and a sheet of white opaque vinyl were therefore selected as dispersion materials. Since each sheet is 0.010 inch thick, a total of 0.020 inch was used as a dispersion for this particular vignette. The reduced positive, which masks the area of desired vignetting, is positioned on the dispersion materials. When this sandwich has been properly assembled in the vacuum frame it is covered with a sheet of clear acetate to form the necessary vacuum for making the exposure. In a typical setup one employs a No. 2 photo flood in a conventional light reflector placed eight feet from the vacuum surface and having a frosted diffuser a few inches from the bulb. An exposure time of about five minutes is necessary for the dispersion materials and magenta screen establish a relatively high exposure factor.

Conventional processing completes the vignette. As the original has been reduced for this particular vignette, enlargement to the original scale is necessary. When the negative has been properly scaled it is registered to the original open window which serves as a mask to form the margins of the completed vignette. This same procedure is practical with almost any enlargement or reduction ratio as well as at a 1:1 scale. Variations in the composition of the sandwich exposure will alter the degree of light migration. Therefore, less diffusion in the makeup can be accomplished by using a thinner vinyl or by the use of diffusers that have less dispersion action. Greater diffusion can also be accomplished by using materials that are thicker or which disperse light more easily because of a grained or opaque-white characteristic. Increased latitude is possible by a manipulation of exposure. A greater than normal exposure on a given sandwich will lengthen the vignette band but create a contrast area immediately around the masked or outlined area.

Overexposure creates a solid line which tapers off to the desired tone or dropout. On the other hand, a less than normal exposure shortens the vignette band and creates a flat vignette. Extreme underexposure greatly shortens the vignette band and creates a flat image varying in tonal range from the darkest tone, 35% to 50%, to a dropout, instead of the normal 90% to dropout. Additional variation can be achieved by control of reduction and enlargement factors. Needless to say, the lines per inch of a vignette vary with the ratio of the final enlargement to the screen ruling of the original magenta contact screen. Consideration should be given to the enlargement ratio in order to obtain the desired dot rulings consistent with the most desirable vignette band.

One other procedure or variable is possible with the photomechanical vignette. This is the ability to obtain an over-all tone rather than the dropout or nonprint white at the extremes of the vignette band. This over-all tone is practical at almost any percent, therefore, if an over-all dot or tone is desired instead of the normal dropout, a flash exposure must be taken. This is accomplished on the open-face vacuum frame, from which the mask is removed to give an over-all flash exposure without breaking vacuum with the base materials. The unexposed film is covered by the magenta screen over which the desired diffusion material is positioned. A clear sheet of acetate is used to vacuum these materials to the open face frame. At the top and outside of the vacuum sandwich a glass positive mask is used to replace the film mask previously utilized. With the positive mask in position, the normal exposure is given as previously described. After the initial exposure, the positive mask is removed and an over-all flash exposure is made. Trial and error will establish the standard operating procedure to produce consistent vignettes of a given type.

LAC STRIP PROCESS

The second problem is not one of portrayal or of symbols which affect the appearance of the chart but deals exclusively with an improvement in production methods. The solution is such a good one that I think it will certainly stand on its own feet and merits a lot of attention.

You are all familiar, I am sure, with gradient tints which fill the spaces between contour lines. The preparation of color-separation negatives that lead to their production is the problem considered here. This procedure has been a great time consumer involving many tedious hours of inking with pen and brush. The inking ordinarily is done by a draftsman who receives the information from the compiler.

The new technique developed by ACIC greatly simplifies past procedure and is achieved by what we call a selective peeling process. This may have been inspired by observing what happens to a girl in a lace bathing suit who stays too long in the sun on her first day on the beach. The new technique has been particularly pleasing because it minimizes possibilities of error. Any technique which improves quality and simplifies procedures is to be cherished.

The *Lac Strip* process was developed by ACIC with the assistance (in the preparation of a suitable lacquer) of the True-Line Process Company of St. Louis. It was developed to prepare line color separations which achieve a photomechanically etched and solvent dissolved negative image of the outline areas of each color tint. The actual open window separation is achieved by a simple strip film procedure.

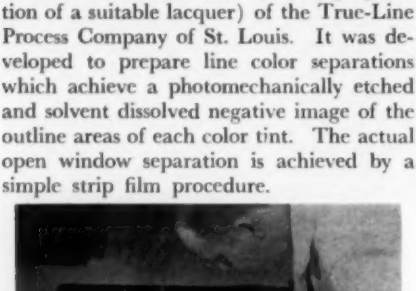


FIGURE 2.

The former method of preparing gradient tint separation (*See* Figure 2) employed the manual paint in or paint out of the desired open-window areas, utilizing a blue- or black-line image to indicate tint limitations. The transition from a nonphotographic blueline image to a black-line image to provide the individual tint outlines was initiated by ACIC to eliminate the difficulty of precise inking along the limits of each tint. Since the black-line limitations are a part of the open window area, a safer margin of registration is achieved by the subsequent overlapping of tint bands by the width of this black line. Further study at ACIC disclosed that certain film coatings could be selectively removed by a photomechanical process of etching and solvent washing. The *Lac Strip* technique is essentially an enlargement of the latter study, incorporating a strippable medium which can be applied as a liquid to form a tough strippable film. *Lac Strip,* as the name implies, is a strippable coating having primarily a lacquer base.

Because of the solvent-etch procedure the stable transparent base presently utilized is Mylar 750, a polyester sheeting developed by DuPont. Basically the finished manufactured stripping is a 0.0075 inch Mylar sheet having an application of a substratum or releasing coat of polyethylene glycol and tergitol solution. This spray-applied substratum acts as a release coat for the after-applied lacquer film. This coating is critical for it has a direct relationship to the stripping quality of the final product. After the substratum has been applied, a plasticized red-pigmented lacquer coating is sprayed on in approximately three coatings of 0.0045 inch for a total thickness of approximately 0.0135 inch.

After the coating is applied, it must be dried and cured. The film can then be stored until used. To prepare a color separation from an original line positive outline a conventional deep-etch stencil is applied. Because the prepared *Lac Strip* sheet contains oil, conditioning prior to the deep-etch coating is necessary. A solution of detergent or French chalk with water will satisfactorily degrease the surface and make it acceptable for the conventional deep-etch sensitizer which is applied at a slightly less than normal whirler speed. An initial speed of 15 to 20 r.p.m. will satisfactorily coat the sheet. The speed can be increased later to accelerate drying. When the sensitized sheet is fully dry, a normal exposure is made, utilizing a positive medium. The image is developed in the conventional manner. The operator should examine the image to be certain that the stencil is fully developed and free from residual deposits. After excess developer is removed, the *Lac Strip* is ready for the solvent etching process.

At this stage a solvent-resistant stencil coating covers the lacquer film of *Lac Strip.* The line detail of the stencil has been removed by exposure and development so that the lacquer film is exposed in those areas. The solvent etch will, therefore, dissolve the lacquer film in the exposed areas while the areas covered by the stencil will not be affected. It is readily seen why this solvent-etching stage will automatically separate the various color-separation bands.

The solvent etching is accomplished much like an amateur photographer develops a

roll of film. This is a very critical stage as the quality of the outline and the subsequent ability of the stripping procedure is dependent upon this operation. The etching formula which has proved most satisfactory is a solution of methyl isobutyl Ketone and ethyl methyl Ketone of equal proportions. These solvents are highly toxic and inflammable.

Breathing the vapor and prolonged contact of the solution with the skin is harmful. Protective gloves and respiratory face masks are therefore essential. Equally important is a satisfactory ventilating system. The actual etching procedure involves rapid immersion with equally rapid squeegee removal of the excess solution. The process should be repeated until the etched image area is free of lacquer or residual. Rapid action is necessary to prevent excessive undercut etching. When the etching is completed, the stencil is removed by placing the sheet under water. The sheet is then allowed to dry thoroughly after which the selective stripping is performed. Any portion or portions of the lacquer film can be removed (*See* Figure 3) within the image limits by inserting a knife point under the lacquer and lifting it. After the desired lacquer film has been removed, the remaining etched outlines can be opaqued or masked to produce a negative suitable for plate making. The stripping phase requires considerably less time than the normal hand operation for the most detailed color separations, such as elevation bands that require detailed artist's interpretation. By creating open windows and removing everything between the image limitation outlines (such as wooded open windows or swamp windows), the work can be completed in a fraction of normal time required for hand painting.

As this is the first ACIC process involving a photomechanical method for creating open-window tint separations, great improvement can naturally be expected.

A deficiency of *Lac Strip* is the inability of the Mylar sheeting to lie perfectly flat. *Lac Strip* sheeting more than 24 by 30 inches could therefore cause registration difficulties. In the surface sensitizer stencil procedure there is the possibility of undercut etching with subsequent loss of quality or detail. This, however, has not proved to be a major difficulty as sufficient latitude is afforded the tint overlap to allow for the normal degree of undercut etching. The problem of adequate ventilation for the Ketone solvents has been eliminated by ACIC by contracting the solvent etching process to the manufacturer.

Research and study are currently under way to improve *Lac Strip* and to eliminate such difficulties as are now associated with this process. ACIC is actively engaged in the development of a stripping product coated on a 0.010 inch vinylite, which is sensitized prior to exposure and developed by water action rather than solvent etching. This type of product would be much like the carbon tissue utilized in the silk screen process.

In the initial phase, a carbon-tissue coating with a rubberized release coat was applied to a vinyl base and sensitized prior to production application. The sensitizing was achieved by inserting the sheet into a dichromated bath until the sensitizer had been absorbed into the strip coating to the vinyl

FIGURE 3.

base. After drying, the sensitized film was exposed by arc lamp in a conventional vacuum frame. A tanning action occurs in the exposed area making it insoluble to mild water action. Because the sensitizer is absorbed within the strip coating, the undercut possibility is eliminated for the tanning action has been through the strip coat to the base vinyl. After exposure a warm water

bath dissolves the unhardened or untanned area or lines so that complete removal of the strip coat in this area is possible. A glycerine bath of the finished sheet will sufficiently plasticize it to allow for the stripping procedure. Since sensitivity is dependent upon the thickness of the strip coat, the color must be strong enough to permit penetration of the actinic rays from the arc. The product in this stage cannot therefore be applied directly as a plate exposure medium.

Dyeing the vinyl in the stripped areas is an additional step to present the necessary barrier for subsequent re-exposure or plate operations. The black beauty formula has proven satisfactory for this purpose. Because dyeing constitutes a reversal, the original is now a positive copy rather than a negative. A photographic contact with the dyed vinyl will give the desired negative and product. After dyeing, the stripped film is submerged in warm water to soften the tanned coating which acts as a barrier in the dyeing process. Simple scrubbing will remove the remaining coating, leaving the impregnated dyed vinyl as the finished positive. The Ulano Product Company of New York has assisted in the basic development of this product. From tests completed and subsequent evaluations, it is obvious that some form of photomechanical stripping product will some day completely replace all major hand operations of this sort.

Author's Note: The technique described above, recently perfected by ACIC, has replaced the *Lac Strip* method. ACIC-coined identity of this new technique is *Dystrip*.

ADJUSTED CONTOURS

One item that we prepared in large quantity at the Aeronautical Chart and Information Center is the mosaic which carries contour overlay. This consists of a white line contour cut through the mosaic cell. The contour lines are traced in standard widths and are adjusted so that they will be adequately predominant in the lightest areas of the mosaic. No provision is made for adjustment of the weight or intensity of contour lines to the background on which they are laid. This results in a difficult viewing situation. When the contour interval is very close it is almost impossible to see the underlying mosaic. This is a problem which was solved in five or six days. Figure 4 illustrates the new technique portraying "adjusted" contours. Note the adjustment that comes about in the lighter field areas as compared to the dark wood areas. The adjustment is obtained by the mechanical procedure here described.

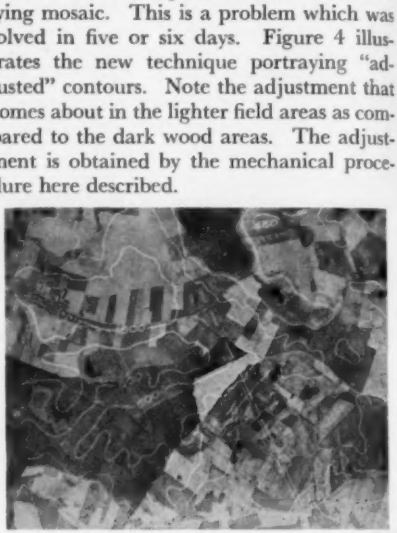


FIGURE 4.

The procedure prescribes photomechanical compositing by means of an auxiliary transparent camera back. (*See* Figure 5) This device is designed with double vacuum channels to permit multiple compositing of both projected and contact materials with comparatively fine registration. As in the case of the two techniques discussed previously, this procedure was developed to reduce man-hours necessary to accomplish a given job. The auxiliary framing device was originally utilized only for straight contact and projected mosaic composites. Its use has since been expanded for other overlay information, such as contours whose tones vary directly or in proportion to the surrounding detail information. The device or auxiliary equipment is simply positioned in a conventional process camera utilizing clamps or bars designed to hold dry plates. The necessary preparatory or precompositing stages for this procedure involve making film negatives or positives of the border frame, contours, or other information desired on the final composite.

In most cases the original materials are supplied in a positive draft or stickup form. A simple contact process is all that is necessary to make film negatives. The original materials should have center marks which correspond to the center lines of the mosaic board or projected image. It is the relationship of these center lines to the center lines of the mosaic board which determine the relative fit or positioning of the two types of subject matter on the final composite. After the negatives are processed, opaquing is necessary prior to making the final holdout positive mask. When opaquing has been completed, film positives are made if a black printed image is required. Since a positive is a holdout mask and the resultant film will be a negative, all detail on this positive will subsequenty print black. On holdout information, such as detail where the white unprinted paper is to show through, it will have to remain in a negative form during the composited exposure.

For a black-printing line border fitted to a projected mosaic halftone having a white

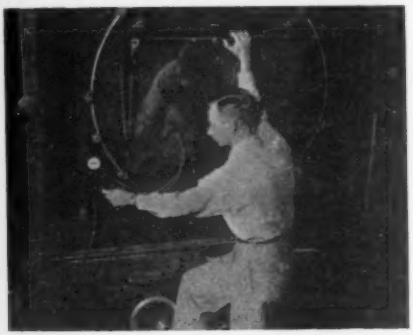


FIGURE 5.

or highlight tone contour image, the following are needed for compositing operations. First, a positive of the border and all black-printing information. Second, negatives of all white or nonprint areas and of all gray-toned information. And third, of course, a positive image or conventional mosaic board of the projection information. Because the border positive and all black-printing information serve as a holdout mask, this must be positioned over the unexposed film and remain in fixed position throughout all stages of exposure. On the other hand, since the negative detail is merely a "burn in" step, it is added at a later stage and subsequently removed.

To follow this procedure step by step, the mosaic board is first positioned on the copy board of the camera making certain that the center marks of the target area have been properly positioned. The area where the projected image is to be stepped is next masked. This is accomplished by attaching red tape to the inside of the border frame, positioned exactly on the black neatline. The area within the border or neatline, outlined by the masking tape, must be covered with opaque black material, film or paper, so the light will not expose the halftone or projected image area. The projected mosaic image is then postioned on the auxiliary or ACIC Transparent Camera Back. This is easily accomplished as the back is provided with both horizontal and vertical etched centering hairlines. Further, the auxiliary back may be rotated to align north, south, east, and west directions. The camera is equipped with a movable lens mount, permitting horizontal and vertical alignment. The copy is now correctly positioned and ready for the compositing exposures. The previously masked positive border is accurately positioned on the vacuum back, registering the center marks of the positive mask to the corresponding center marks of the ACIC back. A sheet of unexposed film is then placed under the mask and the vacuum applied. The positive mask must be of a size sufficient to cover completely the unexposed film and extend to the outside vacuum holes. An overhead exposure of the positive border mask is made with the back in a horizontal position. After the contact exposure is made, the tape and mask attached to the positive are removed. The back is then closed to the vertical position parallel to the mosaic board ready for the required halftone exposures or the continuous tone projected image. After the projected image is made, the ACIC back is again lowered into horizontal position.

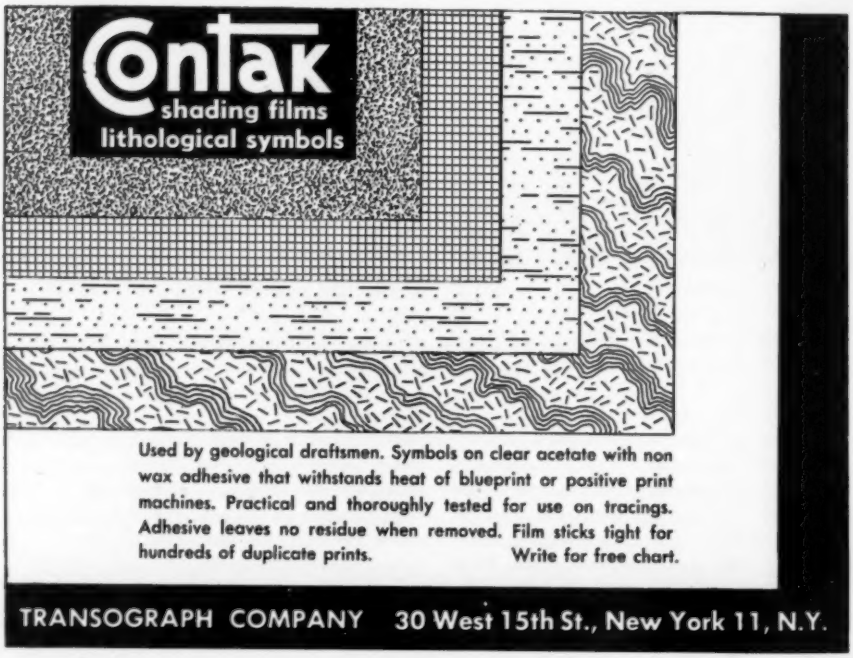
The procedure up to this point requires only the use of the outside vacuum channel,

that is, the channel which is positioned outside the unexposed film but inside the overlay mask. Now, the center vacuum channel is turned on while the outside channel is released. This in effect holds the undeveloped film in position while releasing the positive mask. The negative of the contour is then positioned by the same centering marks used in previous registration. The outside vacuum channel is turned on to hold the new overlay while the center vacuum is released. This changes the overlay film while maintaining the relative positions of all elements. The back is again moved to the vertical position and exposed in the same manner as the conventional halftone or projected image.

With a negative registered to undeveloped film and re-exposed, the detail within the negative film will be subsequently stepped toward the highlight scale in direct proportion to the exposure factor and the reflecting quality of the projected copy. In the case of contours, the exposure is adjusted so that contours running through the highlight area of the mosaic will be nonprint white, while the area of the darkest shadows, would have a printing contour density of 50% and the middle tone area will portray a contour in 25% value. Any number of composites or overlays are practical, and each is independent of the previous one. If a conventional nonprinting white or holdout overlay is required, the normal overhead contact exposure will accomplish the complete dropout. Conventional processing is all that is necessary to complete the framed mosaic negative.

The procedure described above can be completed within one camera hour, which, in most cases, is less time than would be required for hand compositing.

The common denominator of the three procedures herein presented is conversion from hand operation to more efficient photomechanical procedures. "IMPROVED CARTOGRAPHIC TECHNIQUES ARE YET TO BE DISCOVERED." It is hoped that presenation of these procedures may be of benefit to other mapping and charting organizations and that in some small way they may inspire us all in our search for better ways of accomplishing our assigned duties.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The French Cadastral System

By G. H. HALLIDAY

SURVEYOR-GENERAL'S OFFICE, SOUTHERN RHODESIA, AFRICA

EDITOR'S NOTE.—It is quite significant that this discussion of the French cadastral system is written by a surveyor from Southern Rhodesia in Africa and published in a journal in the United States. The reader should note the density of control that is available for cadastral surveys in France in comparison with our own country. Some may be interested in the tax exemptions.

THE French cadastral system was originally introduced, as so many such systems have been, to assist in apportioning the land tax. Later, the cadastral plan also became the basis of the system of registration of land title. Its functions still include these two purposes.

THE CADASTRAL PLAN

Every piece of land is given a distinctive number on the cadastral plan, and this number must be quoted in every deed registered in relation to that land. The scale of the cadastral plan of an area naturally depends on the amount of subdivision which has taken place. In France the scale ranges from 1:250 to 1:4,000.

In addition to the boundaries, the cadastral plan shows buildings. It also indicates whether or not boundaries consist of physical features such as walls, hedges, fences, and ditches, and whether these features are "party," that is commonly owned, or fall on one or the other side of the boundary. All trigonometrical points, existing property monuments, and the intersections of the coordinate graticules are shown, as well as roads and railways.

Working copies of the cadastral plans of each district (commune) are kept in the municipal offices relating to that district so that they may be readily available for public inspection. The property registers relating to the land in that district are also kept in the same office. As there are some 40,000 communes, the convenience of inspecting the cadastral records will be appreciated.

The cadastral plans are drawn in standard-size sections. In the built-up areas it is arranged, as far as this is possible, that public roads shall form the actual boundary of each section of the plan. When new cadastral plans are made, the superseded plans are not destroyed but are kept in the municipal offices and are available for inspection by the public. For ease of reproduction, the originals of the plans are kept in a central organization.

THE SERVICE OF THE CADASTRE

The preparation and maintenance of the cadastral plans, as well as the surveys involved, are the care of a government organization known as the Service of the Cadastre. Because the Cadastre still has, among others, a fiscal purpose, the Service of the Cadastre functions under the control of the Finance Ministry. There is a central office and, in addition, there are regional and departmental offices (France is divided into some 90 departments). In all, the Service of the Cadastre has a staff of some 4,500. Not all of the work of the Cadastre is undertaken by the Service, however. The letting out of cadastral work to private surveyors, on contract, is a regular part of the system.

The principal functions of the Service of the Cadastre can be summarized as follows:

The author has referred to the following publications in preparing this article:

Le Cadastre Francais, R. Herbin and A. Pebereau, Les Editions Francis Lefebvre, 1953, 15 Rue Viete, Paris XVII.

Instruction du 15 juin 1938 pour l'Exécution de la Triangulation Cadastrale, Direction Générale des Contributions Directes et du Cadastre.

Instruction Speciale fixant les conditions d'exécution des traveaux de triangulation, de polygonation, et de nivellement relevant du controle de l'Institut Géographique National, 1949, Institut Géographique National.

Technical

1. Remaking and maintaining the cadastral plans.
2. Amending the cadastral plans to show the new boundaries of land compulsorily redivided to ensure that it shall be economically used.
3. Reproduction of cadastral plans for official use and sale to the public.
4. Standardizing the procedure for large-scale surveys undertaken by public authorities.
5. Installing bases for the standardization of tapes.
6. Maintenance of cadastral trigonometrical points and assisting in the maintenance of geodetic stations.

Judicial

1. Identification and delimitation of properties.

Administrative

1. Establishment and maintenance of property registers.
2. Supplying copies and extracts of cadastral records.
3. Assisting in the valuation of taxable property.

In a recent book about the Cadastre, Herbin and Pebereau emphasize these triple functions, i.e., technical, judicial, and administrative. It is a mistake, they say, to assume that the work of the Cadastre consists only of making a topographical plan.

CONDITIONS OF SERVICE IN THE CADASTRE

The recruiting of the professional and technical staff is solely by way of competitive examination. Age limits for entry are imposed, and the number of places filled by candidates already in the government service is limited to a specified percentage of the vacancies available. Appointments are provisional in the first instance and, at the end of the probationary period, a further examination is required. Later, during the course of their service, the professional staff have to complete additional technical courses. The Administration appoints by choice the Chief of the Cadastre from among the holders of certain specified senior posts. The appointment of a few specified high-level officials is similarly made by choice only.

Candidates for admission to the competitive examinations for the professional and technical staff must agree that, if accepted, they will remain in the government service for a minimum period of eight years. In the event of a candidate leaving the service within the eight-year period, he is liable to pay an indemnity equal to the total emoluments paid to him during the probationary period which precedes his permanent engagement. The payment of this indemnity does not free him from any other disciplinary action which the Administration may take against him. The probationary period is one of a minimum of eighteen months, dating from the acceptance of the candidate after the result of the entrance examination.

The examinations for the technical and professional posts require a high technical standard. The intention appears to be to ensure that those appointed shall learn all subjects which are likely to be of use to them, and shall be physically suited to the work required of them. For the professional examination, the subjects include, in addition to most of the usual mathematical and surveying subjects, political and land economy, civil law, and constitutional law of France. The subjects for the technical examination include rural economy, including soil formation and fertility. Tests in physical exercise are given to all candidates and form part of the examination. As one of the physical tests, candidates must complete a walk of 20 kilometers in less than 4½ hours.

THE NEW CADASTRAL PLANS AND SURVEY

At present a program of resurvey for the preparation of new cadastral plans is being undertaken. These new surveys are based on the new triangulation of France, which is being established by another government department, the National Geographic Institute. The average density of the cadastral triangulation is one point per 100 hectares (about 250 acres).

In 1953 this triangulation had been practically completed with respect to first-order

points, but third- and fourth-order triangulation had been extended over only about a third of the country.

Where the new triangulation has not yet been developed to a sufficiently small order, the Cadastre establishes its own triangulation, and connects it to the major triangulation. This enables the Cadastre to proceed with its work without delay instead of waiting, possibly for many years, for the Geographic Institute to extend its lower-order triangulation to a particular area.

PROPERTY REGISTERS

The establishment and keeping up-to-date of the registers of property is the duty of the Cadastre.

The French land-registration system is not as complete as, for example, the South African system. Steps for a reform of the system have been under consideration for many years and, in March 1953, a Commission was appointed to study the question of the reform of the system of recording mortgages. The Chief of the Cadastre seems, in his book on the Cadastre, to be of the opinion that, when the reforms of the land-registration system have been effected, an organization separate from his should be responsible for the land registers. There should, however, be very close contact between the registry and the Cadastre. This would closely approximate the South African system.

Parts of a building—for example, rooms or apartments on different floors of the building—are shown separately in the register, if separately owned. When the ownership of a building is divided in this manner, plans of each of the separate floors are filed.

PRIVATE SURVEYORS

The survey profession is organized in an institute, the councils of which control it. At the beginning of 1952 the surveyors' institute had 1,641 practicing members. The public authorities are represented on the main council of the institute by a State appointee. The regional councils are elected by the institute members in that region, and the main council is composed of the presidents of the regional councils and four surveyors elected by the regional councils.

Boundary and subdivisional surveys may only be undertaken by members of the profession. Entrance to the profession is by way of examination and the serving of apprenticeship. A four-year apprenticeship must be served with a practicing surveyor or with an approved State service, for example, the Cadastre.

Not all members of the survey institute are entrusted with work by the Cadastre. Before a surveyor is entrusted with triangulation work for the Cadastre, he must make application to the departmental head of the Cadastre. His application is considered by a committee which includes representatives of the Cadastre and other government survey services, and a representative of the surveyors' institute. Acceptance of a surveyor is, if given, at first provisional. The provisional acceptance is only confirmed after satisfactory completion of four contracts covering a specified minimum area. At the beginning of 1953 there were 190 surveyors finally accepted for triangulation work, and 164 provisionally. Less severe conditions are imposed for other work for the Cadastre.

Private surveyors are bound to allow the public authorities to consult their plans and survey records, without charge. It is specified that the surveyor shall not be put to any expense on this account, or held responsible for the information so obtained.

The contracts for triangulation given out by the Cadastre to private surveyors include the reconnaissance, the building of geodetic stations, the observations, and the calculations. Penalties may be imposed on the surveyor if, without good reason, the work is not completed within the time agreed to in the contract.

INSTRUMENTS

Special mention of the Wild T–2 theodolite is made in some of the French survey instructions so, presumably, this instrument is commonly used.

One position of the circle is required when the average length of sight is less than about 10,000 feet and two positions when

the average is greater. In France, in cadastral triangulation, the average length of sight is not likely to be much in excess of 15,000 feet.

STANDARDS OF ACCURACY

The Service of the Cadastre has made considerable investigation of the errors which occur in practice when observations and measurements are made. This has enabled it to assess the worth of a series of observations or measurements, and to relate them to the distribution of errors as calculated from the probability integral.

The distribution of differences according to the probability integral is:

50 percent of the differences should be *less* than the probable error.
32 percent of the differences should be between the probable error and twice the probable error.
14 percent of the differences should be between twice and three times the probable error.
3 percent of the differences should be between three and four times the probable error.
1 percent of the differences should be greater than four times the probable error.

The Cadastre defines a tolerable error, referred to as the "tolerance," as four times the probable error.

For the difference between two base measurements the tolerance is 1:18,000.

MARKING OF STATIONS

Triangulation

All the triangulation points except, of course, church spires, etc., are marked. The Service of the Cadastre has a standard metal mould for the concrete monuments which it erects. If a part of the building, such as a church tower, is fixed as a permanent triangulation station or level bench mark, the owner of the building is notified and, before he makes any modifications of the building thereafter which affect these marks, he must give the administration one month's notice in advance.

Traverse

Sufficient of the main traverse points are marked to give a density of about 5 points per 100 hectares. A concrete monument, similar to the triangulation mark but of a reduced size, is used. As far as possible, though, traverse points are selected to coincide with existing monuments. Sometimes marks are cut in the pavement or rock, etc. A sketch is made of each traverse point. Sufficient information is recorded on this sketch of nearby existing triangulation stations, corners of walls, etc., to enable the traverse point to be reestablished accurately from this information in the case of its disappearance.

Boundary Monuments

Property owners, as well as the State and and all public and local authorities and the railways, must indicate the limit of their holdings when called upon to do so for the purpose of the new cadastral survey, except in Alsace-Lorraine where the marking of boundaries is not obligatory.

BOUNDARIES

The indication of boundaries by owners for the new cadastral survey will, in practice, be made in a variety of ways. In the majority of cases, of course, the boundaries according to the titles coincide with the boundaries on the ground. A delimitation commission is set up in connection with the resurvey, one of whose duties is to endeavor, in the case of dispute, to obtain agreement between the adjoining owners in respect to their boundaries. Failing agreement, the commission provisionally decides on the boundary to be adopted. This provisional boundary becomes definite after a period of a year unless, during that time, the parties otherwise agree, or one or more of them institutes a civil action in the courts to settle the dispute. It will be noted that in the French law the State does not intervene administratively to force adjoining private owners to accept a particular boundary. It is considered that it is better to leave the matter of a boundary to the owners affected to settle themselves; if necessary, in the civil courts.

SURVEY CALCULATIONS

Rectangular coordinates are calculated for all triangulation points, traverse points, and the ends of the principal offset lines. Whenever possible, the graphical method of determining coordinates, which is commonly used in South Africa (the French call this the "point approché" method) is used for fixing cadastral points, and for breaking down from the new French triangulation. It is, in fact, only when the major triangulation has not been completed to a sufficiently low order that other methods, such as chains of triangles, etc., are used.

In the graphical method, intersection, resection, and a combination of these two methods are used. In resection the tangent method is used and the weight of the tangents calculated.

The Lambert projection is used. For France there are three zones, plus a special zone for Corsica. Rectangular coordinates calculated in these zones from this projection are used by the Cadastre.

SURVEY OF THE DETAIL OF BOUNDARIES AND BUILDINGS

The survey of the detail is made by offsets, tacheometer, plane table, or from aerial photographs, depending on which method gives the best results in any area or section of an area. A comparatively reasonably priced instrument for photographic rectification has been developed by the Cadastre. Only the center part of an aerial photograph is used. This center part is limited to a square of side 3/7 of the focal length of the lens with which the photograph was taken. The principle of rephotographing every ten years has been adopted. The areas of properties are calculated graphically from the cadastral plan.

Standard bases are established in every department to enable surveyors to check the steel tapes which they use for traversing.

REPRODUCTION AND FILING OF CADASTRAL PLANS

The redrawing and maintenance of the cadastral plans involves copying over a million existing plans. In addition, copies of these plans are required for sale to the public. A central organization has been created by the Cadastre for making these copies. Two methods of reproduction are used:

1. A heliographic process for work which does not require a very high standard of accuracy and reproduction.
2. A lithographic process for work of precision and a high standard of reproduction.

The photographic transparencies required can be produced either at the scale of the original plan or as enlargements or reductions. For the lithographic process the transparency is, of course, at the scale of the plan. The image size can be exactly adjusted to the original on a ground-glass screen, in the copying camera. For the lithographic process the transparency can be made either on glass or on a plastic (astralon). It is found that with modern methods and materials, a very high fidelity can be obtained with a plastic transparency. The reversal of the image required when an offset printing machine is to be used, is effected by the introduction of a totally reflecting prism in the projection system. For obvious reasons the original cadastral plans are now being filed at the reproduction center, and working copies of these plans supplied to the local offices.

The copies of plans for sale to the public are available in the form of tracings, if desired.

LAND TAXATION

In general, all private land, except land under buildings, is taxed. Farm buildings are exempt from tax. In urban areas the buildings are taxed but the curtilage[1] of a building, provided it does not exceed about 5,000 square feet is regarded as a dependence of the building, and is not subject to tax.

Ideas in regard to the length of the interval between which valuations should be made have varied in the past. The latest proposal is that it should be five years.

STANDARDIZATION OF THE PROCEDURE FOR MAPPING SURVEYS

A central committee has been set up in France to ensure uniformity in the stand-

[1] Land adjacent to a dwelling and used in connection with it.

ards of accuracy of surveys for mapping undertaken by all public bodies, and by any other organizations if the State participates in the cost of the survey. In this manner a survey undertaken by one authority may be used by another authority. Through this committee the control of large-scale mapping—that is, 1:5,000 and larger—has been entrusted to the Service of the Cadastre, and of small-scale mapping to the National Geographic Institute.

The survey requirements of the Cadastre for large-scale mapping are the same as required for cadastral surveys in respect to triangulation and traverse, and it is recommended that, so far as possible, the survey of detail, too, should be in accordance with Cadastre specifications. Before any survey for large-scale mapping is commenced, particulars of the manner in which it is to be carried out, layout of the triangulation, etc., must be submitted to the Cadastre for approval by the public or semi-public authority concerned, or the contractor to whom it entrusts the work. The results of the calculations of the triangulation are examined first, and only when these are approved are the results of the traverses and detail surveys considered.

The survey records of the triangulation and traverses are retained for filing by the Cadastre, as well as the surveyors' reports on the state of the existing control points.

When surveys of this nature are undertaken on contract, a clause has to be inserted in the contract to provide that the results of the work may be used by any of the public services without any further payment.

DOCUMENTS AVAILABLE FOR SALE TO THE PUBLIC

1. Copies of cadastral plans, either at the scale of the original or enlargements, up to 2.5 times, or reductions. These copies can be made either on ordinary paper or on tracing paper.
2. Copies of all plans and sketches made during the revision of the cadastral plans.
3. Copies of aerial photographs, either at contact size or enlargements up to 50 by 60 cm. (20″ by 24″).
4. Extracts from the property registers, including names of adjoining owners.

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Scribed Drawings Successfully Transformed into Effective Positives

By KENNETH R. DEARDORF

CHARTING TECHNIQUES OFFICE, CARTOGRAPHY DIVISION,
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THE well-publicized success of scribing on coated Vinylite has led to almost universal adoption of this technique as a color-separation process by chart and map makers. The advantages of the method have been thoroughly discussed in these pages.[1] Suffice it to say that they outweigh the inconveniences resulting from the substitution of negative originals for positive original drawings. Nevertheless, certain problems were inherent in the new process. One of the most serious was the difficulty in utilizing the unorthodox negative originals.

On drawings prepared with black ink on white paper or transparent plastic it was a relatively simple matter to add type, for names and other information, by cutting out printed copy and applying it to the surface. The scribed original being a negative, however, naturally requires negative type. While it was theoretically and practically possible to use such type, it was an awkward, tricky, and time-consuming task. The type problem has been minimized by using a separate sheet for names. This may be either a film positive, contact printed from the scribed sheet, or a transparent overlay keyed to the original scribed drawing. The "wash-out" process, which etches the type into the sheet independently of scribing is also used. These techniques raised fresh problems, however, such as dimensional changes, additional steps in plate-making, registration difficulties, fuzzy and damaged type, and correcting and editing. Basically, there appears to be no substitute for the original positive drawing for certain applications.

[1] *See* Fuechsel, C. F., "Recent Developments in Negative Scribing," SURVEYING AND MAPPING, Oct.–Dec. 1953. *Also* Fuechsel, C. F., "Scribing Today," SURVEYING AND MAPPING, July–Sept. 1954.

THE QUICK-ETCH PROCESS

Positive, *scribed*, original drawings are now practical, thanks to the research of Robert H. Sovar, Robert H. Sicking, and Julius E. Kahre, of the Aeronautical Chart and Information Center. Success was achieved by converting the scribed negative image into a positive image by staining and etching scribed lines with a dye-etch solution, thus rendering them opaque. The remainder of the coating is then removed. Because of the speed with which the dyeing-etching action takes place, the originators have named their process "Quick-Etch."[2]

The dye-etch solution does not penetrate the coating, but eats into the Vinylite where the latter has been laid bare by scribing tools. The resulting image, an exact replica of the scribed image which preceded it, is etched in the Vinylite, and becomes a part of it. As such it is extraordinarily durable and resistant to chipping, or other damage short of deliberate assault with a sharp knife.

This dyed, positive image somewhat resembles ink drafting but is far superior, for it retains the line perfections characteristic of the scribing process. There is, moreover, never any doubt as to the opacity of the lines, if the dye-etch has been properly applied. With the coating removed, revisions and corrections can be made on the Vinylite with regular inks just as on an ink drawing. Although the lines are durable, they can nevertheless be scraped off readily with a knife when corrections are necessary. Moreover, standard, normal, positive type

[2] Quick-Etch should not be confused with "deep-etch," a well-established term. The latter process produces either positive copies from positive originals, or negative copies from negative originals. Deep-etch copies of Quick-Etch positives can be made, in the event duplicates are wanted.

and the various popular pattern and screen stickups can be applied to it. The image must, of course, have been originally prepared in the form of a "right-reading" positive. Unlike a film positive *copy* of an original drawing, or an overlay *keyed* to it, the end result of Quick-Etch is an original drawing, with all its advantages of freedom from registration and dimensional complications, and minimum number of exposures in platemaking.

In the type wash-out method, line engraving is added after type images have been opened up, thereby promoting damage to the images. In contrast, the dyed-etched image can survive almost unlimited handling. Applied over the image, the type can be applied and removed any number of times, shifted, or even cut on the line work if the cut is not carried too deeply into the Vinylite itself.

PROCEDURE IS SIMPLE

The Quick-Eetch process is basically easy and simple, but specific techniques must be observed because of the nature of the materials and formulas. Detailed instructions on how to perform these operations will not be outlined here. Only the basic steps will be described, so the reader may have a basis for judging the adaptability of the process to his own operations.

The formula for the dye-etch solution is critically balanced. The dyeing-etching function must be completed on the image before the solution has had time, while still active, to penetrate the adjoining coating. It must, therefore, take effect instantly, then cease acting almost as quickly. This demands that the solution be quickly and skillfully applied. The necessary skill, fortunately, is not too difficult to acquire.

(Courtesy MATS, U. S. Air Force, Dept. of Defense)

FIGURE 1.—Engraving on coated Vinylite.

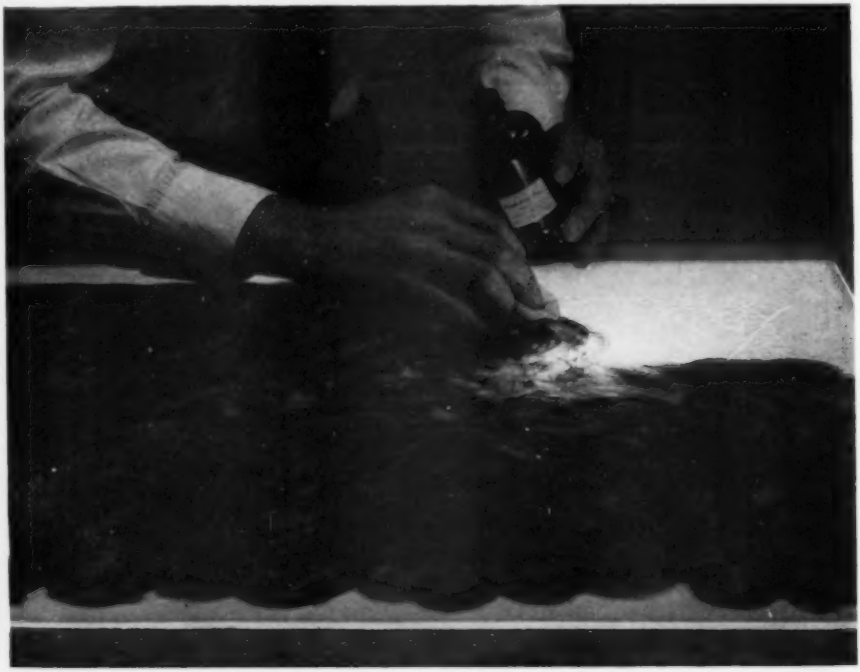
At the Aeronautical Chart and Information Center, drawings scribed in "Fostercote" are sucecssfully treated by this method. The suitability of other coatings has not been comprehensively determined. Other coatings now available may prove to be adaptable to the process either with or without modifications in formula or technique.

ETCHING TECHNIQUE

The engraved sheet (fig. 1) selected for treatment is placed, coating side up, on a glass-topped light-table, and the dye-etch solution is applied, with a compact wad of cheesecloth, to the image with rapid, short, curving strokes (*see* fig. 2). The light shining through the coating and the engraved lines provides a check on the progress of the work, as well as on the opacity of the dyed portions. Because drying is so rapid, the sheet is treated by working small areas.

A potential danger is "burn-through." This results if the dye-etch solution is applied too heavily, or with insufficient verve and smoothness. If the moist solution remains in contact at any point too long, it will penetrate the coating and attack the Vinylite base, causing background discoloration. An air current, directed on the sheet, promotes speedy drying of the solution, and prevents this condition. Should discoloration occur, however, it can be readily removed.

After the sheet is dyed, it may be set aside or stored for an indefinite period. In its dry state, the dyeing-etching action of the solution is halted. While the sheet coating may continue to darken with time, there is no further danger of background discoloration.



(Courtesy MATS, U. S. Air Force, Dept. of Defense)

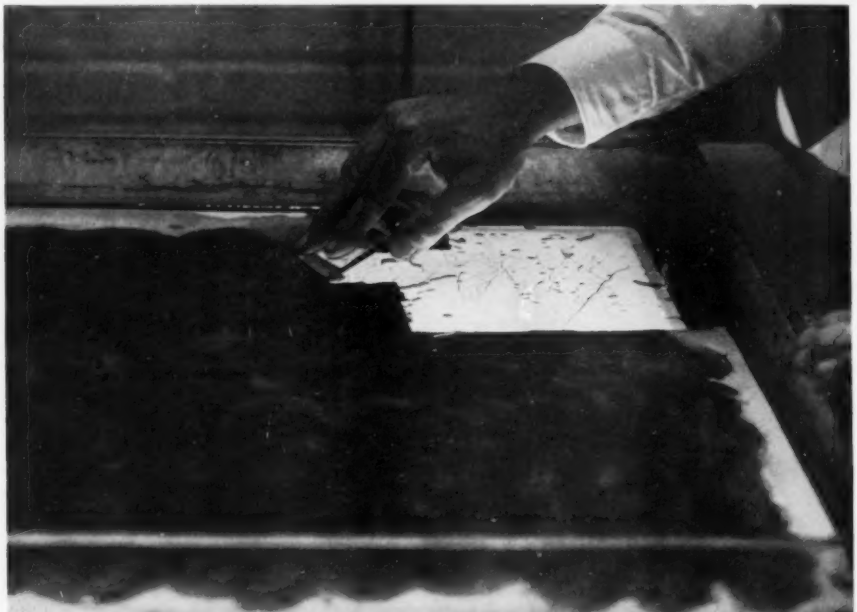
FIGURE 2.—Applying Quick-Etch dye to engraved sheet.

To prepare the sheet for use, and obtain the desired positive appearance, it is necessary to remove the original coating. There are two ways to accomplish this. The volume of work to be done is a factor in choosing between the two. If the volume is heavy, a tray, large enough to accommodate flat drawings, should be acquired. Such a tray will permit convenient handling of the sheets and some reuse of the removal liquid. The sheet is immersed, coating upward, in denatured alcohol and allowed to soak a few minutes, after which the coating can be removed with a plastic scraper (*see* fig. 3). The scraping can be quite vigorous without the slightest damage to the dyed image. Upon removal from the tray, the sheet is wiped clean and bits of coating which cling to it are rubbed off with a cloth dampened with denatured alcohol.

The tray used at the Aeronautical Chart Plant is made of transparent plexiglas. This permits its use over a glass-topped light-table, so the coating-removal progress can be watched.

If the volume of work does not warrant manufacture of a tray, the denatured alcohol may be applied by hand. The sheet is placed on a table, alcohol is applied freely, and the coating scraped as in the tray operation. Although this is less manageable than the tray method, the end result is the same.

A few precautions should be observed. Adequate ventilation is essential, as the dye-etch solution contains volatile and inflammable ingredients. Ordinary air conditioning seems to be adequate. Rubber gloves and aprons are needed to prevent staining of hands and clothing.



(Courtesy MATS, U. S. Air Force, Dept. of Defense)

FIGURE 3.—Removing the coating.

REVIEW OF SCRIBING DEVELOPMENTS

The development of a successful reversal dye process for engraved images on coated Vinylite was not unanticipated. The principle has been long visualized and discussed, and the secrets of a successful formula and technique much sought after. The convenient utilization of type is perhaps the least dramatic of the applications made feasible by successful conclusion of the search.

Taking a few steps backward to get a running start, let us review briefly the advantages of scribing as a cartographic technique, and then take a small hurdle into the future. The first true scribing or engraving, utilizing coatings of various non-actinic colors, evolved from the traditional black-and-white negative cutting, after many false starts and dead ends. A relatively short time ago, a more pleasing light green replaced the previously standard red coating at the Aeronautical Chart Plant. Now Quick-Etch permits coatings of *any* desired color or shade, including transparent ones. Since the coating is to be removed, the color is immaterial.

The practicable use of a *white* coating is a most interesting and significant development. Lines scribed in a white coating while the sheet is resting on a dark (ideally, a matte, jet black) background, have extraordinary contrast, like fine India ink drawings on white Bristol board. This makes it possible to dispense with the cumbersome and fragile glass-topped light-table, for scribing can now be performed on an ordinary drawing board or on any convenient flat surface. The importance of this to the field and small office can well be imagined.

NEW DEVELOPMENTS TO BE EXPLORED

Within certain limitations, not fully explored as yet, the use of transparent or translucent coatings may permit chart compilation directly in the form of color-separation drawings. This application contemplates laying the coated sheet directly upon the source material, or upon "pull-ups," and tracing selected detail with a scribing tool. There are undoubtedly existing compilation situations in which this method would be practical.

The fact that the Quick-Etch image need not necessarily be dyed black may lead to other developments whose potentialities are not yet fully defined. Black is currently being employed. However, many other colors and shades, non-actinic and otherwise, are feasible. The contour image may be dyed brown, the drainage image may be dyed blue, and so on. Encouraging results have even been obtained from experiments in dye-etching more than one color on the same sheet. The technique stands available whenever a new need may appear.

FORMULA FOR QUICK-ETCH DYE

The Quick-Etch dye (as currently formulated) is composed of two parts: (1) a base, which contains the vehicle and etching elements, and (2) the dye itself.

The base consists of:

60 grams	Vinyl chloride acetate[3]
1024 cc	Acetone
100 cc	Cyclohexanone

After the vinyl has become thoroughly dissolved, which normally takes several days, the dye is added. For a black image, this consists of:

22 grams	Grasol Blue 2GS[4]
13 grams	Grasol Red GBN[4]
8 grams	Orasol Yellow 3G[5]

Although the dye formula for black is the only one given here, because of space limitations, any desired color and shade can be obtained by using the appropriate dye or dyes. The same base is used for every color. The possibilities have by no means been fully explored, and further experimentation may yield better dyes and bases than those now in use, including the presently quite satisfactory black.

[3] Vinylite sheeting shredded to convenient size.
[4] Geigy Company, Inc., N. Y.
[5] Ciba Company, Inc., N. Y.

Large-Scale Engineering Topography By Photogrammetric Methods

By C. J. ALSTER

ALSTER & ASSOCIATES, WASHINGTON, D. C.

BEFORE DISCUSSING the subject of large-scale topography, I should like to qualify my remarks by stating that most of my views are based on my own experience in the commercial aspect of stereophotogrammetry, and that my firm's activity in large-scale work has been based only on the use of Kelsh-type plotters without pantographs. With these instruments, we have completed a wide variety of large-scale topography, but it is inevitable that other firms have a differing approach to the problem by the use of other types of instruments.

As a matter of definition, when we speak of large-scale engineering topography, we are really speaking of maps having a scale of 1 inch = 400 feet, or larger, with 1-, 2-, or 5-foot contours. With vertical aerial photography, the photogrammetric method thus far is limited to a scale of approximately 1 inch = 50 feet, with one-foot contours. Mapping at a scale larger than this by photogrammetric methods, with reasonable accuracy requirements, borders on impracti-

Presented at the Fifteenth Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., Mar 9–11, 1955.

Kelsh plotters like the one pictured above are used by Alster & Associates for compiling large-scale maps.

cability. With convergent photography and appropriate stereoplotting equipment, however, perhaps the day is not far off when we can do better.

LOW-ALTITUDE PHOTOGRAPHY PROBLEMS

The process of preparing large-scale topography with vertical aerial photography is one involving difficulties which are proportional to the scales and contour intervals required. The larger the scale or the smaller the contour interval, the greater are the problems. The most difficult problem is that of obtaining suitable aerial photography at the low altitudes necessary to achieve accurate large-scale map requirements. For example, photography at low altitudes requires more stability of aircraft than at higher altitudes because of image movement. Turbulence is a constant problem at low altitudes. To stabilize aircraft in turbulent air at low altitudes we need heavier air craft. But with heavier aircraft there are greater problems of ground-speed/shutter-speed ratio since it is difficult, if not impossible, to slow down heavier craft to avoid image movement.

At higher flight altitudes these problems become less serious. At 3,000 feet above mean terrain or higher, the problem of ground-speed/shutter-speed ratio is relatively minor. Flight-height/relief ratios likewise become less serious although the turbulence factor is still a critical one, since 3,000 feet is not generally a smooth-air altitude.

In addition to the difficulty of obtaining movement-free photography, there is the shadow problem resulting from high ratios between ground relief or tall ground features and flight heights. For this reason, obtaining low-altitude photography in sunlight over certain types of terrain is impractical at certain times of the year when the sun is low in the sky. Under these circumstances, acceptable results may be achieved by obtaining photography on overcast days. To do this, the camera lens aperture would have to be increased, or the exposure time would have to be increased. With increased exposure time, however, the aircraft-stability and air-speed problems become more critical; with a larger aperture opening, we can expect a sacrifice in resolution of the photographic image.

Assuming photography is obtained in a satisfactory manner, other problems enter that are not significant in smaller-scale mapping. For example, because of the relative sparsity of cultural features, the choice of good photo control points is limited. The stereocompiler also has difficulties. He cannot place the floating mark in the center of an image with the same confidence he has when working with smaller-scale models; with overcast less-sharp photography, achievement of close accuracies is difficult.

Another very significant factor involves the order of accuracy of control needed to achieve large-scale accuracy requirements. A foot or two of error in a field survey is normally insignificant for smaller-scale maps; however, for large scales like 1 inch = 50 feet or 1 inch = 100 feet, a foot is measurable and can affect the final accuracy of the map. For this reason, field control established by third-order methods may not satisfy specified horizontal and vertical map-accuracy requirements.

PLANNING FOR LARGE-SCALE TOPOGRAPHY

Aside from the problems of photography and visual factors in large-scale stereo mapping, there is an affinity between map scale and contour interval. We shy away from planning a job solely around the contour-interval requirement when it might be necessary to enlarge the compilation manuscript to the desired map scale. We therefore often plan flight altitudes primarily to achieve the horizontal-accuracy requirement, with tolerance to spare in plotting contours. A typical case is in mapping at a scale of 1 inch = 100 feet with a 5-foot contour-interval requirement and a planimetric-feature position tolerance of 1/40 inch, or 2½ feet. This is not easy to achieve, but at a plotting scale of 1 inch = 100 feet it is possible. This horizontal accuracy requires a flight height of 3,000 feet, but with photography at this altitude we can, in most instances, furnish 2-foot contours, with half-

interval accuracy, with relatively little more expense than is involved in furnishing 5-foot contours. From this, it is obvious that the relationships between horizontal scales, contour intervals, and accuracy requirements have a great bearing on the economic factors involved in planning and achieving large-scale topography by photogrammetric methods.

The problems in large-scale topography by our method have also brought up the subject of "C-factor," and it seems appropriate to comment on its role in large- and small-scale mapping problems. C-factor is generally known as the ratio of the contour interval to the flight height of the aircraft above the ground. The C-factors adopted for use were originally conceived by considering primarily the vertical relationship between the acuity of stereoscopic perception of the compiler and the model-scale value of the contour interval, along with the type of stereoscopic model created. The C-factors adopted were also influenced, however, by the fact that field control is an expensive phase of the subject, and therefore the choice was based on a minimum of four vertical control points per model, one in each corner.

In large-scale stereocompilation, other considerations influence the C-factor. With large-scale photography, the cost of establishing vertical control in the centers of the stereoscopic models is relatively small and therefore the density of control may be balanced with the other factors. The C-factor must obviously be influenced by this consideration, although we must be careful not to carry this theory too far, lest we find ourselves advocating an excessive number of control points to insure stereocomparagraph compilation accuracy. Other considerations that have some influence on the C-factor include the type of country and the experience and skill of the stereocompilers. Of course the accuracy and adequacy of the field data must be commensurate with the stereocompiler's skill. The size of the project, which influences the number of compilers involved, might also have a bearing on the flight planning for a particular project.

URBAN-AREA COMPILATION

Our experience has included two large-scale mapping projects that particularly exemplify some of the problems I have discussed in this paper. One was a map requirement for 140 acres at 1 inch = 30 feet with 2-foot contours. The area was urban and the houses were frame type with overhanging eaves. The horizontal accuracy requirement was 1½ feet. We photographed the area at 1,500 feet on an overcast day. The models were not sharp but better than we had expected, especially since they leveled exceptionally well. The plotting scale was 1 inch = 50 feet, but since we had an interval of 0.51 millimeters between contours and a field elevation on every street intersection, giving an average of 12 vertical photo ties per model, we compiled 1-foot contours in lieu of the 2-foot contours required. We copied the manuscript onto blueline boards at the final scale of 1 inch = 30 feet and our client completed the survey by planetable, adding underground and other invisible structures. It was also necessary to establish house locations in the field since it was not feasible to obtain accurate foundation locations in the stereo models by assuming concentricity under roof outlines. This was the only weakness in the map. Other planimetric features checked within the requirements and the average error of the contours was 0.37 foot.

MAPPING OF AIR FORCE ACADEMY SITE

The other project is still current. It is the Air Force Academy site, located at the eastern foot of the Rockies, just north of Colorado Springs. The western portion of the area being mapped is quite rugged with tall pine-tree cover, while the eastern portion is gently rolling and devoid of vegetation. The project requirement was twofold: a map at a scale of 1 inch = 400 feet with 5-foot contours for a total area of 35,000 acres, and a map at a scale of 1 inch = 100 feet with 2-foot contours for a 15,000-acre portion within the 35,000 acres. The first priority was the map at 1 inch = 400 feet and it was one of those "we-need-it-yesterday" projects.

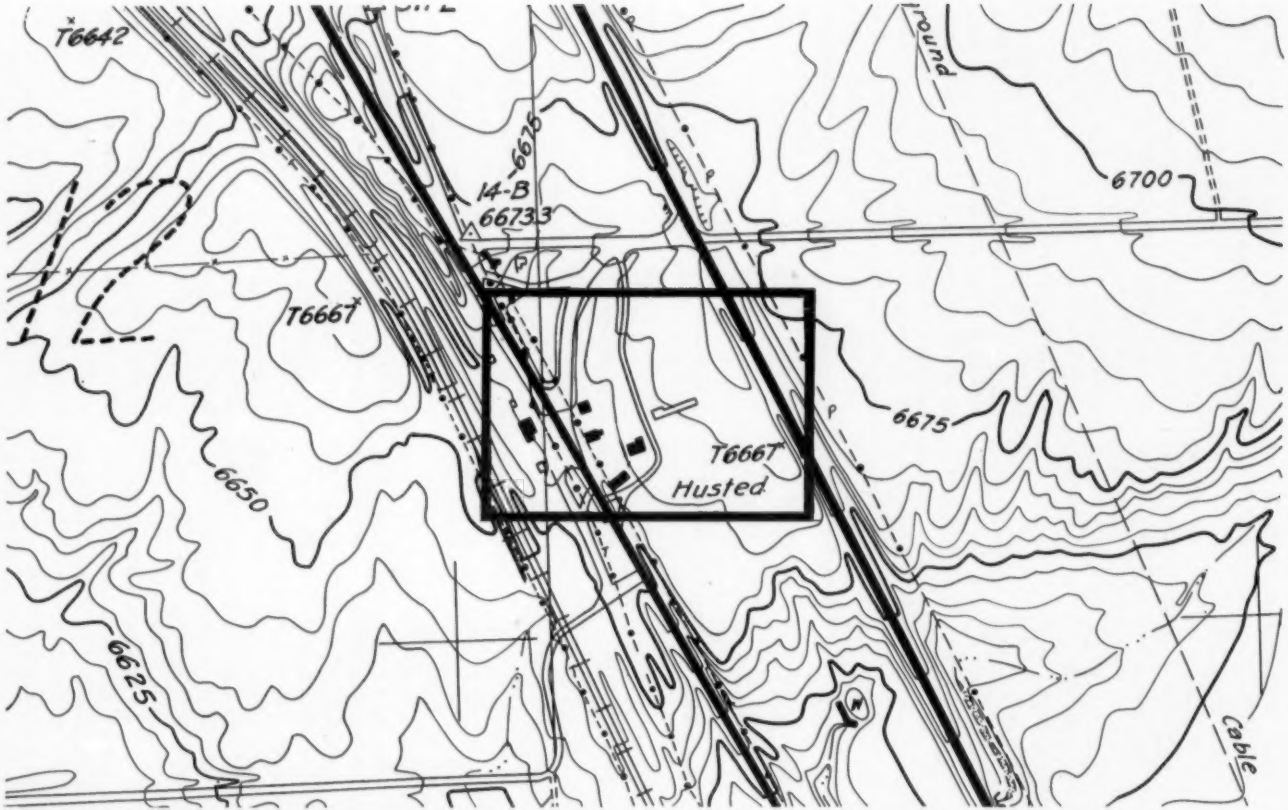
With this priority, the photography was obtained at three altitudes: 12,000, 6,500 and 3,000 feet above mean terrain. The topography at 1 inch = 400 feet was accomplished by use of both the 12,000- and 6,500-foot photography. Prior to obtaining the photography, we field-panelled 13 existing triangulation stations. These panels showed up well on the photography. Horizontal pass points were selected on the 6,500-foot photography and transferred to the 12,000-foot photography. Stereotriangulation was accomplished with the 12,000-foot photography by orienting and adjusting to panelled triangulation stations and establishing postions of all photo-identified pass points. These pass points were transferred to larger-scale plot sheets and used as horizontal control for the 6,500-foot photography which was used to compile the first-priority map requirement. The plotting scale was 1 inch = 200 feet where possible, but for some of the western strips we used 1 inch = 240 feet. Film positives were prepared from these plot sheets to a scale of 1 inch = 400 feet and traced on linen. Nineteen tracings were required to cover the 35,000 acres. This high-priority phase of the project was delivered in October, 1954.

The 3,000-foot photography was planned for the second requirement: scale of 1 inch = 100 feet and 2-foot contours. Since the original 15,000-acre area could have been selected in any portion of the 35,000-acre area, it was necessary to cover the entire 35,000 acres with this lower-altitude photography. While 3,000 feet is not considered extremely low compared to some large-scale requirements, many problems were encountered on this project at that altitude. The photography was obtained in early August. At that time of the year the skies in that area are usually clear until about 9:30 in the morning when cumulus clouds appear. The tall pines on the steep hills called for high-noon photography, but since this was prohibited by cumulus clouds, most of the photography was obtained at about 10 o'clock. At that time of day, however, it seemed that calm atmosphere was not to be had at that altitude and we were faced with a triple problem of cumulus clouds, shadows from tall timber, and turbulent atmosphere. The result was that we obtained an abundance of photography and were able to meet the requirements with one set or another.

While the first-priority topography was being completed, our field crews established additional control consisting of bands of traverse and level lines and supplemental control tailored to the 3,000-foot photography. Prior to the completion of the first-priority topography, the large-scale topography requirement was increased from the orignal 15,000 acres to 20,400 acres. There were 168 stereoscopic models compiled to cover the 20,400 acres. The compilation scale was the same as the map-scale requirement: 1 inch = 100 feet. Of course, this is ideal since the undressed compilation manuscript may be placed under tracing linen without reproduction. The entire project is now practically complete. Of 132 linen tracings required for the 20,400 acre area, 99 have been delivered and we hope to deliver the remaining sheets within 2 weeks.

A project of this type could be simplified if the first priority were the larger-scale requirement, in which case the smaller-scale requirement for that portion of the project could be accomplished by a relatively simple drafting-and-reproduction process. Such was not the case for this project because one of the requirements for the topography at 1 inch = 400 feet was to afford a means of selecting the portion of the 35,000 acres desired for the construction area. The map at 1 inch = 100 feet with 2-foot contours was required only for the construction area. In this instance, the priority requirement made it tough, but all's well that ends well, and to our knowledge all work delivered thus far complies with all requirements.

As a closing statement, I should like to summarize by saying that large-scale topoggraphic mapping by photogrammetric methods is not a simple nor a routine operation. Nevertheless, we photogrammetrists accept it as a challenge and it is a very interesting occupation.



A section of an Air Force Academy topographic sheet at a scale of 1 inch = 400 feet with a 5-foot contour interval. The inset outline area is the same area as represented on the opposite page at a scale of 1 inch = 100 feet with a 2-foot contour interval.

A section of an Air Force Academy topographic sheet at a scale of 1 inch = 100 feet with a 2-foot contour interval.

A section of an Air Force Academy topographic sheet at a scale of 1 inch = 400 feet with a 5-foot contour interval. The inset outline area is the same area as represented on the opposite page at a scale of 1 inch = 100 feet with a 2-foot contour interval.

Duties and Liabilities of the Surveyor Where Land is Transferred by Unwritten Means

By CURTIS M. BROWN

DANIELS, BROWN & HALL, SAN DIEGO, CALIF.

GENERAL

IT IS a well settled principle that land may be transferred by parol means in California, despite the requirement of the State Code that deeds shall be in writing to be valid. Although a person must acquire the *initial* right to a parcel of real property by a written deed, he can gain portions of adjoining land or lose portions of his land by the acts and conduct of himself and his neighbors, or by acts of nature. In other words, the *original* right to land must be based upon a written document; but, after land has been acquired by writing, under certain circumstances it may be added to or subtracted from by parol means, by acts of the adjoiner, or by acts of nature.

SCOPE

It is not the intent to present a detailed analysis of the means by which land might be transferred by unwritten conveyances, but sufficient data will be presented to bring about an intelligent understanding of the following problem confronting the surveyor: Is surveyor permitted to recognize unwritten ownership lines, or must he stake out only that which is written? If he is permitted to recognize unwritten ownership lines, under what circumstances may he do so, and what is his liability?

UNWRITTEN MEANS OF TRANSFERRING TITLE

The more important methods of land conveyancing between adjoining owners without written considerations are:

(1) Estoppel,
(2) Agreement,
(3) Recognition and Acquiescence,
(4) Adverse Rights,
(5) Statutory Proceedings,
(6) Accretion and Erosion, and
(7) Escheatment.

Other means such as practical location and private survey are essentially variants or subtypes of the above.

ESTOPPEL

The doctrine of estoppel is based upon the theory that where a party by his acts, declaration, conduct, admissions, or omissions misleads another so that the other is induced to injure himself to the benefit of the person misleading him, the party causing the wrong must suffer the loss and is estopped from revealing otherwise. A party is estopped from telling the truth where he has falsely and deliberately misinformed another so as to cause improvements to be built to his benefit. In California this principle is based upon the Code of Civil Procedure, Section 1962, part 3; "Whenever a party has, by his own declaration, act or omission, intentionally and deliberately led another to believe a particular thing true, and to act upon such belief, he cannot, in any litigation arising out of such declaration, act or omission, be permitted to falsify it."

Four things are essential for the doctrine of estoppel to become effective:

(1) The party being estopped must know the facts.

(2) The party being estopped must intend, or at least act so the other has a right to believe that he intended, that his conduct shall be acted on.

(3) The person claiming estoppel must be ignorant of the facts.

(4) The person claiming estoppel must have relied to his injury on the conduct of the person being estopped.

Estoppel is a denial of the truth and is not looked upon with favor by the courts. All of the above points must be proven conclusively. A hypothetical example of estop-

pel occurs if Mr. Brown points out to Mr. Smith a line which he knows to be 20 feet from the true line. Mr. Smith not knowing where the true line is, accepts the line pointed out and grades and paves a drive for his benefit. Mr. Brown promptly claims the drive as his own, but is estopped at law from doing so.

AGREEMENT

Boundary lines agreed upon by oral means and by contiguous owners may become the ownership lines if

(1) The true line is unknown,
(2) The line is in dispute, and
(3) The owners agree to accept the line they establish. Where such line agreed upon is built up to and substantial loss would result in a change in position, or where the line is built up to and acquiesced in for the statutory period, the line becomes the true boundary line.

It is certain that adjoining property owners cannot establish a line between their lands by agreement if they know the location of the true line. In such a case a properly written conveyance, based upon a consideration, and containing words of conveyancing, must be used.

If the coterminous owners are attempting to establish the true property lines, and they err in establishing the true lines, they are not agreeing to a line but merely establishing what they believe to be the true line. In such case the owners are not denied the right of claiming to their true lines. If a line is capable of being established by a survey, and the parties agree to have the true line established by a survey, and the surveyor errs in the establishment of the true line, the adjoining owners can claim to the true line since no other line than the true line was agreed upon, However, if after the error was discovered there was acquiescence for the statutory time or if there was title by adverse possession, the survey lines would be binding.

In the event that one party misrepresents the lines, or deceives the other, the agreed lines are not binding except on the person misrepresenting the lines. Fraud cannot be the foundation for an agreement. The fact that the lines agreed upon are not the true lines is immaterial to the validity of the agreement; the lines need only to be in dispute and unknown. Owners of adjoining land, or those having vested interests therein, are the only ones who can establish the disputed line by agreement. An agreement between owners, but not including the mortgage holder, is not binding upon the mortgagor.

Parol agreement upon a line is an exception to the rule that all deeds must be in writing to be valid. The idea of a parol agreement is not to convey real property, but to agree to fix the location of that which is already owned and is uncertain. If either party knows the true location of a line, parol agreement fixing another line is void because it amounts to a conveyance by parol means. Where an uncertain line is agreed upon, but at a later date one of the parties finds that the true line could have been ascertained, the line agreed upon cannot be disturbed. In the event that a parol agreement is made and then not followed by acquiescence and possession, the agreement is not binding. Possession need not be physical in the sense of cultivation, but may consist in the erection of monuments or marking the line.

RECOGNITION AND ACQUIESCENCE

Recognition and acquiescence are dependent upon the statute of limitations to become operative. In California a line recognized and acquiesced to for a period of five years may not be disturbed. Civil Code of Procedure, Section 318 states, "No action for the recovery of real property, or for the recovery of the possession thereof, can be maintained, unless it appears that the plaintiff, his ancestor, predecessor, or grantor, was seized or possessed of the property in question, within five years before the commencement of the action." Section 319 of the same code states, "No cause of action, or defense to an action, arising out of the title to real property, or to rents or profits out of the same, can be effectual, unless it appears that the person prosecuting the action, or making the defense, or

under whose title the action is prosecuted, or defense is made, or the ancestor, predecessor, or grantor of such person was seized or possessed of the premises in question within five years before the commencement of the act in respect to which such action is prosecuted or defense made."

STATUTORY PROCEEDINGS

Statutory proceedings in California are limited to court actions. In other states, by law, certain officials may establish property lines, and at the expiration of a limited time, if the lines are uncontested, they are conclusive.

ADVERSE RIGHTS

Occupancy of a parcel of land for a period of years, along with certain acts by the possessor, will confer a title against all except the public. In California for any adverse claim to ripen into a fee, the following acts must be complied with continuously for a period of 10 to 20 years:

(1) Actual possession,
(2) Open and notorious possession,
(3) Continuous possession,
(4) Hostile possession,
(5) Exclusive possession,
(6) Under color of title, and
(7) All taxes must be paid.

A person claiming adverse possession must have actual possession by such acts as fencing, cultivating, weeding, farming, and improving. A survey, where boundaries are marked, does not indicate actual possession unless the owner follows the survey and improves or cultivates up to the line of the survey.

Possession must be open and notorious such that the owner of the fee title could by occasional visits observe the acts of possession. Possession of the land must be continuous during the statutory period, since any interruption restores the possession to the rightful owner. It is not essential that the same owner be in possession, for tacking on of successive occupants is permitted.

Hostile possession must be against the interests of the fee owner without any admittance on the part of the adverse claimant that the land in question is not his. If at any time the land is rented or leased from the fee owner by the adverse possessor, or if he admits he does not own the land, interruption occurs and the statutory period must start over.

Possession must be exclusive and cannot be shared with the rightful owner, since the owner will never have been deprived of possession. Where by appearance a title exists, yet none actually exists, the term "color of title" is applied. If a subdivision is made and monumented in such a manner as to include a portion of the adjoiner's land, a buyer, buying one of the lots improperly subdivided, would have color of title.

In California taxes must be paid continuously for five years preceding the action for adverse rights based upon a 20-year occupancy. If taxes are paid continuously for a period of ten years, action for adverse rights may be initiated at the end of the ten years.

ACCRETION AND EROSION

Accretion is the process whereby soil is accumulated by imperceptible degrees upon the bank of a body of water. Erosion of land by imperceptible means is the reverse process.

ESCHEATMENT

Escheatment occurs when the state assumes ownership of land due to failure of the former owner to pay taxes, assessments, or the like.

DUTIES OF THE SURVEYOR

The question being considered is: What are the duties and liabilities of the licensed land surveyor in the event fee has passed by unwritten means?

Three of the stated parol means of transferring title can be eliminated from further consideration. Statutory proceedings are certainly not within the scope of the surveyor. Land gained by accretion or lost by erosion is a measurable quantity which, by law, can only be measured by the surveyor. While the division line between properties may be difficult to determine due to ambiguous questions arising when interpreting

common laws relating to accretion, the surveyor must make that determination since he is the only one authorized by law to make land measurements. The methods used, however, are always subject to review by another surveyor or by the courts.

Escheatment is a process of law, vital to the owner and title company, but not within the scope of the surveyor.

The remaining means of transferring title by oral conveyances have one thing in common. Parol evidence under oath must be taken to determine the rights of adjoining land owners. The statutes relating to surveyors in California note that surveyors may take parol evidence by oath where

(1) It is necessary to identify or re-establish old, lost, or obliterated corners, or where

(2) A monument is in a perishable condition. Nothing permits the taking of parol evidence which will assist in the determination of ownership of land acquired by unwritten means.

The law does not prohibit a surveyor from establishing survey lines or points in accordance with the lines of possession, but if he does so on his own initiative he is assuming the burden of proof. He must prove, even in court if necessary, that the lines of possession are the correct title lines. In view of the fact that such proof requires considerable parol evidence and that the process is complex and expensive, a surveyor cannot afford to take such a risk.

The key to the question regarding the liability of the surveyor in the event he establishes points based upon the lines of possession rests in the instructions given to him by the owner of the property being surveyed. Liability results where the surveyor fails to correctly do the thing that he purports to do. If the owner tells the surveyor to survey his land in accordance with his written deed and the surveyor does precisely that without error, no liability can ensue. If the owner tells the surveyor to survey his land in accordance with the lines of possession regardless of the written title lines and the surveyor does just that, no liability can ensue.

Assuming that a surveyor may mark property in accordance with possession (and there is authority that under certain circumstances a surveyor should so do) what is the effect of such markers and what ethics are involved?

Normally it is assumed by the public—and often by the surveyors themselves—that all property markers found represent points set in accordance with written deed lines. If an owner, whose stakes have been set in accordance with a line of possession, points out to his neighbor a survey marker and states, "This is my property line," deception can occur. The adjoiner assuming that the surveyor may not take over the duties of the court and that he may not declare for certain that a line of possession is the true title line without proper court action, is apt to be mislead. If the adjoiner discovers the truth, that the markers are merely lines of possession, he will more than likely seriously question the ethics of surveyors. For this reason our office has adopted the policy of seldom marking the lines of possession. When we do, it must be an extremely clear-cut case where we can prove to our own satisfaction, beyond a shadow of doubt, that possession is the only logical answer. Before setting such markers, we make certain that the owner understands the situation; that he has consented to such procedure in writing, or by oral means in the presence of witnesses; and that a plat is sent to him showing the true written deed lines, as well as the lines of possession as staked. By doing this, liability is avoided and the plat cannot be used as a basis to mislead another party, such as a title company insuring title, into believing that the written lines and the lines of possession are in agreement.

Existing California laws make it mandatory that the surveyor shall, when setting stakes not in agreement with the written title, file a record of survey since evidence is found that by reasonable analysis might result in alternate positions of lines or points. Facts of possession and title lines must be clearly shown on the plat.

The opposite situation, where a surveyor marks the written title lines and finds encroachments that might be title lines, does not present potential deception on the part of the surveyor. The surveyor can and should explain to the client that the encroachments might be title lines, and where the encroachments have stood for five years they cannot be disturbed regardless of the written title. In this manner the surveyor is not placed in an unfavorable position to an unknown adjoiner.

Establishing lines based upon possession invites criticism and conflict between surveyors and the public. A surveyor setting markers on the written title line, but out of agreement with another surveyor who has marked the line of possession, makes it appear to the public, and with just cause, that the surveyors do not know what they are doing.

SUMMARY

In order to avoid liability in surveys involving unwritten deeds, a surveyor must be certain that he is following the instructions given him by the owner, or the responsible party requesting the survey. He may stake out written deed lines, or lines of possession, without incurring liability provided he follows exactly and precisely the instructions of the owner. Only by misrepresenting the lines of possession as being the written deed lines, or by misrepresenting the written deed lines as conforming to the lines of possession, can liability ensue. To avoid placing the surveyor in an unfavorable light to the public, marking lines of possession should be avoided excepting where

(1) A court has ruled them to be the true title lines, and excepting where

(2) Extreme extenuating circumstances make the lines of possession the only logical solution. If the line of possession is marked, such fact must be clearly indicated to the client, and it must be shown in relationship to the true written deed lines on a filed record-of-survey plat.

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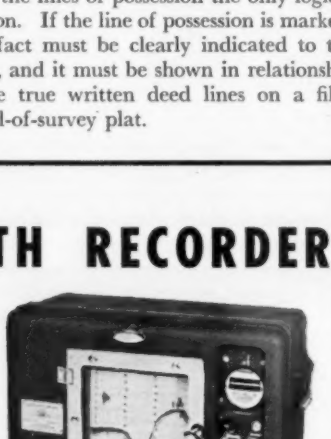

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Accomplishments of the Inter American Geodetic Survey

By COL. ROBERT R. ROBERTSON
DIRECTOR, INTER AMERICAN GEODETIC SURVEY

WHEN Hitler moved into Poland in 1939 and World War II began to be recognized as such, military leaders the world over made a hasty assessment of the available map coverage. These strategists discovered, with something of a shock, what the cartographer had long known—the world, with a few exceptions, was not accurately mapped. When it was all over and an appraisal undertaken, it was concluded that the lack of suitable maps was one of the major deterrents to the ability of the United States to wage global warfare. The immediate reaction was a great interest in world cartography for, regardless of previous isolationist tendencies, the very rapid development of the airplane during the war made it apparent that, even though unwilling, the United States had suddenly become a neighbor to all the rest of the world.

As the question of maps, or rather the lack thereof, was considered, several interesting facts emerged. It became more generally realized that the military was only one of the users of maps and that maps were the little appreciated foundation on which much of mankind's peacetime progress was based. It was further discovered that, under the necessity of war, great advancements in equipment and techniques had been achieved which made it possible to quickly and accurately map large or small areas utilizing aerial photography.

MAPPING PROGRAM IN THE AMERICAS

This new appreciation of the importance of maps reached the highest governmental levels with the result that, with the cessation of hostilities in 1945, the President directed letters to the Secretaries of State, War, and Navy suggesting that the time appeared opportune to undertake a comprehensive mapping program in foreign areas whose governments were friendly to the United States. This action initiated a world-wide mapping program under the guidance and with the assistance of the United States. The technical and political implications, ramifications, and general problems inherent in such a program are monumental. Almost everyone has felt or witnessed the suspicious and inhospitable attitude the local land-owner exhibits toward the surveyor-intruder whose line crosses his property. Multiply this provincial attitude by an international factor and you have a faint idea of what had to be faced.

A history of the world-wide mapping and charting program would make many volumes of extremely interesting reading. However, no volume would be more interesting than that dealing with the mapping program in the Americas. This element of the world-wide program is unique in that the organization, methods, and results have no parallel. The story of this program is the story of the Inter American Geodetic Survey.

In implementing the world-wide mapping program, responsibility for the areas of Mexico, Central and South America, and the Caribbean Islands was assigned to the Caribbean Command. The program for these areas directed by the Department of the Army is known by the short title MAPPLAN and envisages a cooperative program in which the Air Force would obtain aerial mapping and charting photography, produce aeronautical charts, and furnish air support; the Navy would obtain beach and off-shore hydrographic data and produce nautical charts; and the Army would obtain

Presented at the Fifteenth Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., Mar. 9–11, 1955.

the geodetic and allied data and produce topographic maps. Actually the IAGS, a major subordinate command of the U. S. Army, Caribbean, is the only agency exclusively devoted to the prosecution of MAPPLAN. This organization, well known throughout the Americas, is presently collaborating with all the Latin American countries except Argentina, Paraguay, and Uruguay. This collaborative effort initated in 1946 is accomplished under diplomatic agreements negotiated through Department of State channels between the United States and other governments concerned. Besides the American Republics, agreements have also been completed with Great Britain, France, and The Netherlands covering their possessions in Latin America.

Generally the objective of MAPPLAN is to map the Americas. This is being done by assisting the collaborating countries to become both proficient and self-sufficient in the conduct of geodetic surveys and the production of topographic maps. The immediate benefit to be derived is two-fold. First, maps are essential to the effective joint planning of the hemisphere's defenses. Second, and just as important, maps are essential to permit the republics of Latin America to economically develop the vast wealth in natural resources locked up in the jungles and towering mountain ranges so prevalent in this part of the world. Ancillary to the immediate tangible benefits are the intangible benefits of accrued scientific knowledge concerning the size and shape and geophysical characteristics of the earth. The objectives of MAPPLAN in more specific terms are:

(*a*) To obtain aerial mapping photography and all geodetic and allied data necessary to prepare topographic maps, hydrographic and aeronautical charts.

(*b*) To secure a strong geodetic tie between North and South America.

(*c*) To assist the collaborating countries to become self-sufficient in all phases of surveying and production of maps.

(*d*) To foster standardization of mapping equipment and procedures.

(*e*) To create good will and foster hemispheric solidarity.

ORGANIZATION OF IAGS

To accomplish these objectives, MAPPLAN authorizes IAGS to assist the collaborating governments by the loan of equipment, the provision of technical advice and assistance, the training of personnel, and, where a country is unable, the physical accomplishment of any phase of the work using U. S. personnel and resources. It is desired to point out and emphasize that this is a truly cooperative and not a "give away" program. IAGS operates on a two and one-half to three million dollar annual budget, but the estimated expenditures by the collaborating countries exceed this amount by four to five times.

While IAGS is a military organization, many of its personnel are civilians. The organization consists of 25 officers of the Corps of Engineers, 17 warrant officers, 42 enlisted men, and 280 civilians. An officer from the U. S. Coast and Geodetic Survey is on detached service with IAGS as a technical consultant. Also IAGS has assigned to it the 937th Engineer Aviation Company with 56 officers, 1 warrant officer, and 101 enlisted men. This unit has 24 light fixed-wing aircraft and 20 helicopters which are used to support the mapping operations. The 551st Engineer Base Survey Company with 131 men and 3 officers has recently been assigned to IAGS. Thus there are about 650 individuals in the IAGS organization. The program overall, considering the organizations of the collaborating countries, involves an annual expenditure of some 12 to 14 million dollars and employs over 5,000 individuals utilizing some $50,000,000 worth of plant and equipment.

For its part IAGS, from its headquarters in the Canal Zone, controls, supervises, and supports a field organization that is spread over 10,000,000 square miles. It is over 6,000 miles from its most northerly to its most southerly area of operation. Every type of climate and terrain is encountered, from the steaming tropical jungles of the Amazon to the frozen lofty peaks of the Andes.

IAGS field organizations in each country normally consist of an Officer-in-Charge,

an administrative warrant officer, a supply non-commissioned officer, 5 to 10 geodetic engineers (depending on the magnitude of work underway), 2 or 3 military pilots and aircraft mechanics, an automotive mechanic, and 1 or 2 supply personnel. Most of the actual work is accomplished by the collaborating agencies and a large part of IAGS' $6,000,000 worth of equipment is on loan to these agencies. The IAGS personnel are there to encourage the various governments to use accepted methods of working and advise and give on-the-job training to the local personnel as required. They are also there to advise and assist in the use and maintenance of U. S. supplies and equipment. In some instances where a country does not have a sufficiently large organization or budget IAGS personnel accomplish certain phases of the field work.

SCOPE OF THE PROGRAM

Translating the objectives of the IAGS program into hard facts means the establishment through tropical jungles and over 17,000-foot mountain ranges of more than 90,000 miles of primary arcs of triangulation and 195,000 miles of primary level lines. It means measuring 250 baselines, establishing 350 astronomic stations, installing and observing 200 tide gages, and determining magnetic declinations and gravimetric variations at 3,000 geophysical stations. This is a considerable chore which at the present time is about 50 percent complete. But this is just the preliminary phase. Concurrently with working toward completing this basic work we are entering the next phase—obtaining photography, establishing mapping control, compiling, drafting, and reproduction. With an area of about three times that of the United States, this phase too is a project of considerable magnitude.

As to accomplishments, after some 8 years of expanding effort, progress on the MAPPLAN program includes the completion of 45,000 miles of triangulation, 55,000 miles of levels, 150 base lines, and 250 astro stations. Further, practically every country participating is now able to carry out all phases of cartography from basic field surveys to the reproduction of finished map sheets. This is true even though a few years ago such an accomplishment would have been viewed as highly improbable.

Included in the 45,000 miles of primary triangulation is a series of arcs extending from the United States through Mexico and Central America to South America and down the west coast thereof to the vicinity of Puerto Aysen in Chile at about 45° south latitude. This is some 6,500 miles which, combined with similar work in the United States, Canada, and Alaska, constitutes over 11,000 miles of arc reaching from Pt. Barrow, Alaska, nearly to Cape Horn. Although the longitudinal displacement amounts to about 85°, this longest series of conventional triangulation in the world will be most helpful in the studies now underway to develop a new figure of the earth.

In prosecuting its program IAGS has participated in a number of rather unusual projects. For example, just this year a base line was measured in Peru with the assistance of an Army Map Service geodimeter team. The unusual aspect is that the elevation of this base line is almost 14,000 feet. Also in Peru, we recently completed a first-order arc of triangulation, 21 stations of which averaged 14,600 feet in elevation. As I recall, the highest peak in the United States is 14,495 feet. The 14,600 feet I mentioned was an average. The highest station was 17,500 feet. First-order level lines have been run at the extremes of 16,000 up in the Andes and 150 feet below sea level in the Dominican Republic. We have a number of level lines that run 650 miles between tidal determinations without a check at an intermediate datum. One line runs over a thousand miles, tying points in Colombia and Ecuador together without an intermediate check. Of course the longest is a transcontinental line from the Pacific to the Atlantic—about 2,700 miles across Chile, Bolivia, and Brazil. Nowhere along this line were check elevations available. Eventually all lines will be supported by a system of loops.

We have had some extended operations in horizontal work also. The longest conventional sight on our records is 215 miles. This was done in 1952 and tied Turquino,

Cuba, to Macaya, Haiti. The elevations of the two stations were 6,500 feet and 7,900 feet respectively. Surprisingly, our longest flare observation was only 150 miles.

Some of the things we have found are also of interest. Field elevations of first-order level lines across Mexico at Tehuantepec, across Panama at the Canal, and across northern Colombia all indicate a mean sea level difference between the Pacific and the Gulf of Mexico and Caribbean Sea of about 19 centimeters with the Pacific being the higher. However, the tidal ranges at these same points vary a great deal. On the Atlantic side the extreme range is less than two feet at the above-mentioned points while on the Pacific side it varies from over 23 feet at the Panama Canal to less than 6 feet in the Gulf of Tehuantepec.

There are some existing maps of Latin America—road maps, aeronautical charts, and even some topographic maps. However, they do have inaccuracies. As an example, there is, within 60 miles of the Panama Canal, a 125-mile-long range of mountains which rises over 5,000 feet high but does not appear on any existing maps. There are areas of the Panama coastline for which the best maps available were compiled from 1854 British Admiralty charts. Many major mountain peaks have been found out of true position on existing maps, some by as much as 40 miles. Some of these same peaks have been found as much as 5,000 feet in error in elevation. There are areas where the highly important Amazon River does not match by 10 miles on adjacent map sheets.

TANGIBLE AND INTANGIBLE BENEFITS

The benefit of the IAGS program has been dramatically demonstrated numerous times. Its level net permitted the development of a large irrigation project in the Artibonite Valley in Haiti. In Cuba, an extensive water-table survey which resulted in the development of 500 wells was possible because of our basic leveling system. In Costa Rica and Guatemala, several million dollars have been saved in the location of highways because of the availability of topographic data. There are areas in the almost inaccessible Peruvian jungles where oil can be seen on top of the ground. These areas are being mapped in preparation for the day when this oil will be needed. And so it goes throughout all the countries. As soon as surveys are completed and maps produced, highways, railroads, hydroelectric plants, irrigation projects, reclamation programs, etc., inevitably follow. Maps are basic.

I have spoken of tangible benefits which can be evaluated in dollars and cents. There are other less tangible benefits which though a by-product of the main IAGS program are, to my way of thinking, of even greater value. I am speaking of the good will which the program has engendered. I believe that the wholehearted, enthusiastic cooperation of all the countries and the fact that 75 percent of the cost is borne by them is ample evidence of this, but it goes further. Realizing that maps are essential to progress, interest is evidenced at the highest governmental levels. In my visits to the participating countries I invariably call on the various ministers and high staff officers of the military. Many times I am invited to call on the President himself. It is not unusual to have IAGS military personnel receive high decorations from the governments concerned when they complete their tours and depart for their next stations.

I mention this because it is my personal but firm opinion that no area in the world is of more importance to the United States than this hemisphere. When the rest of the world has been either dominated or rendered impotent by unfriendly governments then, to survive, the Western Hemisphere must act as a coordinated whole. Between Canada, the United States, and Latin America there exist the basic necessities of manpower, natural resources, and the know-how to use them required to stand off the rest of the world. But, two things are essential to full realization of these advantages—the trust and good will of the countries concerned, and maps. IAGS is doing its share to assure fulfillment of these requirements.

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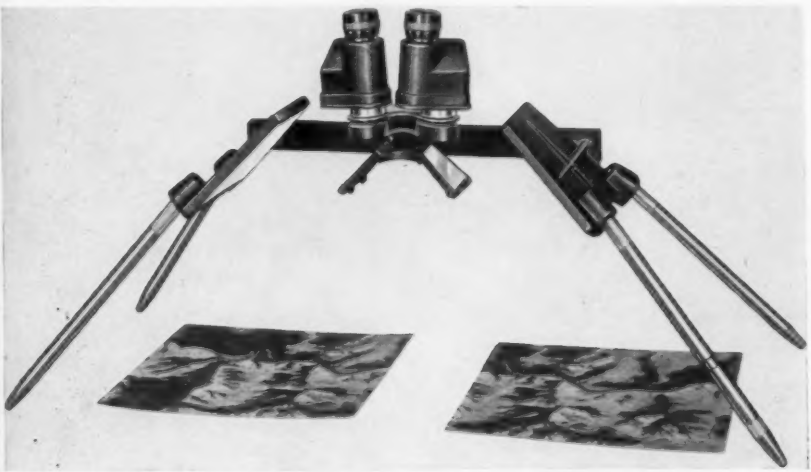

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American Manufacturers Announce Wind-Free Plummets

THE EDITORS of SURVEYING AND MAPPING have received separate announcements from two American manufactures, W. & L. E. Gurley and the David White Company, regarding the development of wind-free plummets.

Gurley optical plummet

The optical plummet principle has been successfully adapted to the American transit by W. & L. E. Gurley. According to the manufacturer, the new Model 57-FRH-20 transit provides advantages to be gained from optical-reading theodolites, in addition to many points of superiority of a standard transit. It will sell for less than imported theodolites. The new time-saving version of the Gurley Hell Gate Transit also features a shifting center which permits move-

GURLEY OPTICAL PLUMMET TRANSIT

ment of the transit in two directions at right angles to each other, with little disturbance to the level of the plate. The optical plummet is, therefore, operative practically continuously during centering.

Essentially, the Gurley optical plummet is a telescope through the optical center of the transit, pointing vertically when the transit plate is level. The reticle in the telescope consists of three concentric circles with lines at right angles leading to the center circle, which is just large enough to match the stake tack of the station point at the ordinary set-up height. To permit ease of observation, the plummet telescope is turned at right angles by means of a prism, so that the observer actually looks through the telescope horizontally. Repeated, time-consuming leveling while centering over a point is eliminated by the new shifting head. The objective lens of the plummet is sealed and protected by a small, plain glass insert.

To set up the new-model transit, a plumb bob plug can be pushed into the tripod, and the bob used for initial rough centering. Most instrumentmen set up by eye after a little practice. When the tripod and instrument are nearly in place, the tripod bolts are tightened and the plate leveled and the plumb bob plug removed (if used).

The plummet telescope's reticle is focused by moving the eyepiece in or out. With the clamps on the shifting head loose, the tangent screws are used to move the center circle over the station point. The plate is releveled, if necessary, a final plummet-centering adjustment made, and the shifting head clamps tightened. Centering is checked by revolving the instrument around the spindle. It should remain on the station point in all positions

An extra-rigid tripod with fixed-length legs 54 inches long is used with the optical plummet transit. The transit weighs 15 pounds including shifting center.

Further details are available in Bulletin OP-57 which may be obtained from W. & L. E. Gurley, Engineering Instrument Division, Troy, N. Y.

David White optical plummet

The David White Company, of Milwaukee, Wis., has announced two new wind-free plummets, one an optical type, the other a telescopic-rod type.

The automatic optical plummet, made to fit both European and American tripods,

DAVID WHITE OPTICAL PLUMMET

offers many advantages over the antedated plumb bob now in common use. The instrument is unaffected by high winds, is self-leveling, and is light in weight. This new plummet is designed around a double-image sighting system. The observer looks through a window at the side to see two images of the stake tack. These two images move into coincidence when the instrument is directly over the tack.

DAVID WHITE TELESCOPIC-ROD-TYPE PLUMMET

The precision optical system is enclosed in a durable aluminum-alloy housing which is dust- and moisture-tight. A standard connector is provided to fit all popular makes; adapters for all recognized makes are available at nominal cost.

David White telescopic-rod-type plummet

David White's telescopic-rod-type plummet is a new low-priced mechanical device which is fully automatic, completely unaffected by the wind, and a great time saver on survey jobs.

The telescoping rod is made of high-strength aluminum-alloy tubing for long life and accuracy. It is fitted with an 8-minute level vial, giving an accuracy of 1/64 inch in its entire length. This can be reduced to zero by turning the plumb rod through 180 degrees and centering the bubble reading.

The wide range of adjustment of this device makes it applicable to almost any kind of tripod; it can be used on steep hillside locations where one leg of the tripod is completely closed. The device is designed to fit both European and American standard tripods. Adapters are available for all popular and recognized makes of instruments.

Further details are available from David White Company, 315 W. Court St., Milwaukee 12, Wis.

1956 ACSM-ASP CONSECUTIVE MEETINGS AND CO-EXHIBIT
March 19–24, 1956, Washington, D. C.

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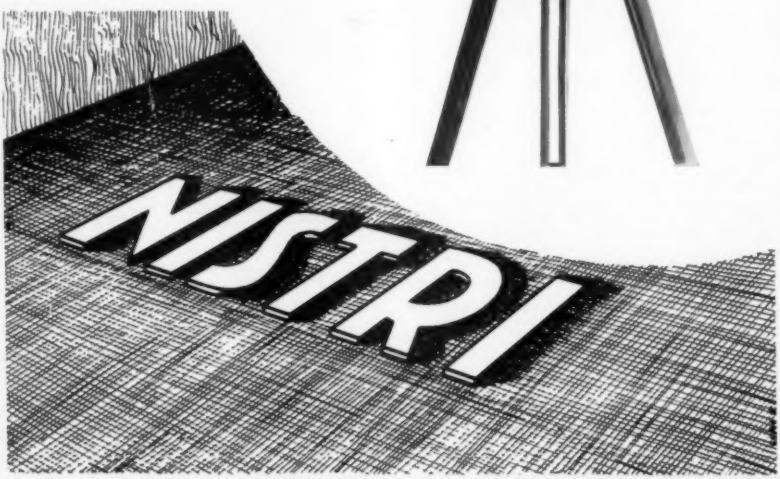

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The Mont Blanc Topographic Map of the French Institut Géographique National

By WILLIAM HANNAH
CARTOGRAPHER, TUCSON, ARIZONA

FIVE SHEETS*, of a projected special series of 24, of the Mont Blanc area in the French Alps, have recently been published by France's Institut Geographique National. This large-scale (1:10,000) multi-colored topographic series will, when completed, cover about 320 square miles of this mountainous section of the country.

The maps are compiled by photogrammetric methods utilizing the Poivilliers stereoplotting apparatus, and are completed in the field. Compilation is facilitated by checking numerous relief models, by stereoscopic studies of aerial and terrestrial photographs of rock masses, and by sketches made in the field by specialists in the vertical interpretation and design of rock and ice formations.

The maps portray mid-summer conditions and are published in 12 colors and wash-tints, using 10 printing plates: black for works of man and lettering; red for masonry constructions; blue for drainage and glacial relief contours; blue relief shading for glaciers and permanent snowfields; light brown for relief contours; dark brown for bare rock outcroppings, with rock relief contours wherever applicable; brownish-violet for relief shading; yellow for barren upper slopes; pale green for valley fields; a superposition of yellow and pale green tints designates mountain pasture; a forest-green wash-tint showing forest-green for evergreen woods and, by superposition on the yellow tint, light green for deciduous woods. Evergreen and deciduous woods are further differentiated by characteristic strokes of the wash-brush; also, the thicker the woods, the darker the shading of the respective green wash-tints.

Printed on heavy paper with legend and complete marginal data, all the maps except *La Flégère* cover areas measuring 5 centesimal minutes of latitude by 10 centesimal minutes of longitude on sheets 30 by 36 inches. The *La Flégère* map measures 30 by 41 inches. The Lambert conical conformal projection is used, and the contour interval is 10 meters. All lettering is by hand.

The Mont Blanc series represents a unique blending of cartographic science and artistry. The sheets are remarkable for their precision, finesse of execution, and sheer beauty in variety of colors judiciously chosen. Utmost clarity and legibility prevail despite inclusion of meticulous terrain detail for this region of difficult access.

At the present official exchange rate (one U. S. dollar equals 350 francs), the cost per sheet, unfolded (including wrapping, tax, and first class postage to points in the United States and Canada), is $1.95. When ordering in quantity, add $1.35 for each *additional* sheet: thus two maps cost $3.30, three $4.65, etc. Payment is required in advance, by International Postal Money Order or by New York cheque (personal cheques are not accepted), to Institut Géographique National, 107 Rue La Boetie, Paris 8, France.

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* Chamonix-Mont Blanc, LaFlégère, Servoz, Les Houches, and Aiguille du Midi.

French marginal annotations, topographical nomenclature, abbreviations, and all the symbols appearing in this series may be obtained by sending 25 cents in coin to William Hannah, 2601 East Helen St., Tucson, Arizona.

H. Arnold Karo Appointed Director of Coast and Geodetic Survey

H. Arnold Karo, appointed by President Eisenhower to be Director of the Coast and Geodetic Survey, with the rank of Rear Admiral, was administered the oath of office on August 17, 1955, by Assistant Secretary of Commerce Lothair Teetor.

H. ARNOLD KARO

Admiral Karo was born December 24, 1903, at Lyons, Nebr., where he attended elementary and high schools. He was graduated from the University of Nebraska in June 1923 with a degree in civil engineering. After his graduation, he entered the commissioned service of the Coast and Geodetic Survey with the rank of Ensign. His service included 22 years of sea duty aboard various ships engaged in surveying the waters of Alaska, the Philippines, and along the Atlantic, Pacific, and Gulf coasts of the United States.

During World War II he was transferred from the Coast and Geodetic Survey to the United States Army Air Forces. Beginning in June 1943 he served for more than two years as Commanding Officer of the Aeronautical Chart Plant, St. Louis, Mo. He entered on that assignment at a time when the plant had just been established and was not yet in full operation. As a result of Admiral Karo's administration and guidance, outstanding achievements were accomplished in organizing the plant which is now recognized as being among the important map reproduction plants of the world.

In 1950 Admiral Karo commanded the *Explorer* engaged in an important survey project in the Bering Sea. During the summer of 1951 he represented the Coast and Geodetic Survey at the British Commonwealth Survey Officers' Conference in London, England. He is a recent graduate of the Industrial College of the Armed Forces, Fort McNair, Washington, D. C., and during the past four years he has served as Chief of the Chart Division of the Coast and Geodetic Survey.

Admiral Karo is a member of the United States Naval Institute, American Society of Photogrammetry, Society of American Military Engineers, and the American Congress on Surveying and Mapping. He is representative for ACSM on the National Research Council. He also holds membership in the national honorary scientific society Sigma Xi and the national honorary engineering fraternity Sigma Tau.

Admiral Karo resides at 6307 Kirby Road, Bethesda, Maryland, with his wife and two children, Douglas Paul and Kathryn Rosalie. His eldest son, Arnold M. Karo received his doctor's degree in physical chemistry in 1952 from the Massachusetts Institute of Technology and is now engaged on a special research project at that institution.

The Stepping Method of Stadia

By E. L. HARRINGTON

DEPARTMENT OF CIVIL ENGINEERING, AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

THE STEPPING METHOD is very useful in determining elevations by stadia when vertical angles are small. A discussion of this method may be found in many surveying texts, but frequently the student fails to appreciate the value of this simple technique. Young surveyors who have not used this trick will find it easy to learn and to apply.

In practice, the method is used as follows. To "turn up" one step, point the telescope at the rod, level the telescope, and see where the upper stadia hair intersects some well defined object. Watch this object through the telescope and, with the slow-motion screw, turn the telescope up until the lower stadia hair occupies the position formerly occupied by the upper stadia hair. The telescope is now "+ one step" or the line of sight is set on a + 1% grade. Additional steps may be turned up by continuing the process. Half steps may be set if desired. Always record the rod reading, R, where the horizontal cross-hair intersects the rod, before resetting the telescope to facilitate reading the stadia distance.

To "turn down" one step, point the telescope at the rod, level the telescope, and see where the lower stadia hair intersects some well defined object. With the slow-motion screw, turn the telescope down until the upper stadia hair occupies the position formerly occupied by the lower stadia hair. Additional steps may be turned down by continuing the process.

As in other stadia methods, elevations should be taken with the telescope horizontal whenever possible.

Three examples of the computation of elevations by the stepping method are given below. In each case it is assumed that the H. I. (elevation of the horizontal line of sight) is 1000.0.

(a) + 1 step, $R = 3.2$, obs. dist. = 100 ft.
Elev. = $1000.0 + (1 \times 1) - 3.2 = 997.8$

(b) + 3 steps, $R = 5.6$, obs. dist. = 375 ft.
Elev. = $1000.0 + (3 \times 3.75) - 5.6 = 1005.7$

(c) − 3 steps, $R = 11.2$, obs. dist. = 700 ft.
Elev. = $1000.0 - (3 \times 7) - 11.2 = 967.8$

These computations involve only addition, subtraction, and simple multiplications which may be done rapidly without a slide rule.

Stadia notes may be kept on the left-hand page of the notebook in the following manner, the right-hand page being used for sketches or other descriptive matter.

TRANSIT AT TRIANGULATION POINT A AND ORIENTED. H.I. = 978.4

Point	Distance	Azimuth	Steps	R	Elevation
1	75	224°15′		7.5	970.9
2	160	268°45′		9.3	969.1
3	480	109°	+1	3.1	980.1
4	115	178°20′	+4	0.6	982.4
5	200	65°	−4	10.7	959.7
6	370	47°30′	+½	1.6	978.7
B	435	45°32′		10.2	968.2

The stepping method of stadia is particularly useful when elevations must be computed quickly in the field. Stepping always is started with the line of sight horizontal, consequently no index error is involved. This is particularly helpful when using a planetable alidade that has no vernier-control bubble.

Accuracy of elevations is comparable with that of other stadia methods, up to about 4 steps, a vertical angle of about 2°. No correction is made for horizontal distance.

The Thing That Steals the Land*

By FORREST DANIELL

CIVIL ENGINEER, THE TEXAS COMPANY, HOUSTON, TEXAS

IMAGINE YOURSELF being scalped by Indians yet living to tell about it; scouting unarmed in Indian territory; or, in the agony of death, carving your own tombstone. These and many other hardships faced early heroic frontier land surveyors of Texas, who, by their sacrifices, helped to prepare the way for the prosperity which Texas people in all walks of life now enjoy.

The present citizens of Texas, as well as those of past generations, have had only a faint idea of the daily exposures, hardships, and perils to which the Texas pioneers were subjected. For many years, especially during the eighteen thirties and early forties, these people were harassed by either the Mexican nation or roving bands of cruel savages. Indian raids and murders continued unabated even after Texas was annexed to the United States. There is no known record of the number of gallant surveyors who forfeited their lives as the purchase price in those early struggles to locate our rich lands.

THE PIONEER SURVEYOR

Ever since the first settlement in America, the Indians had watched their lands disappear before the incessant advance of the white man. (*1*)† Thus it was only natural that the red men had a hatred for the surveyors and for the surveyor's compass. Strange as it may seem, there were many friendly Indians. An Indian, who was given a surveyor's compass and had it explained to him, responded that he would keep it and use it when the stars were asleep.

The whole frontier of Texas was aflame in 1838 with savage warfare. The immediate cause of hostilities was the opening of the General Land Office early in the year. Land locators who were anxious to obtain the best lands had surveyors go out beyond the settlements to begin their operations. The Indians, watching the surveyors at work, believed that the Mexicans had told them the truth when they said that the white settlers would take all their hunting and fishing grounds and drive them from the State. The cruelty of and destruction by the Indians was no doubt, in large measure, caused by this state of affairs. The Mexicans, who had lost Texas at the Battle of San Jacinto, sought to revenge themselves by inducing the Indians to wage a guerrilla war upon the Texans.

Present-day surveyors have no conception of the constant anxiety and suspense endured by the Texas pioneer surveyors nor their need for eternal vigilance to avoid being surprised by the restless Indians. (*2*)

They constantly took notice of every sound, especially the uneasiness of horses or cattle, and the noises of wild animals. These pioneer surveyors, like other pioneers, were quick to detect a false note in the calls of bobwhites. They knew that the answering calls were signal calls of the Indians. The surveyors read the compass, cut brush along the boundary lines, and chained distances—with rifles at their sides.

THE OLD SURVEYOR'S NOTEBOOK

Mentioning the rifle at the surveyor's side, reminds me of the story by Henry D. Ralph in the Oil Journal some years ago. It seems that an old surveyor in west Texas kept a lot of notes, but his corner markers could not be found where his notes called for them to be. The oil company's surveyor was puzzled. He blamed the Indian raids and buffalo stampedes for confusing the old surveyor's work. The surveyor thumbed through the old notebook, which contained many little sketches, and stopped at a sketch

* The Comanche Indians called the surveying compass "The Thing That Steals the Land."

† Numbers in parentheses refer to items in the list of references at the end of the article.

showing the old surveyor's camp. On the front tent pole was draped a cartridge belt, a holster, and a Colt. The surveyor reasoned that this was a logical clue—if the old surveyor wore his six-gun while surveying a line, the metal in it would deflect the compass needle from its normal position. A trial line was run on a course calculated to include the deviation of the compass caused by a gun; however, the corner marker could not be found. He returned for further study of the old notebook and discovered by the hang of the cartridge belt in the sketch that the original surveyor was left-handed and probably wore his gun on his left hip. The confident surveyor ran a third line on a course calculated to allow for the deviation of the compass caused by a gun on the left hip. At the end of the line he found the original corner marker where the old surveyor said he located it.

OTHER INDIAN STORIES

Evidently some surveyors were not anxious to meet Indians for any price. In September 1835, two unnamed surveyors whose compasses were at Natchitoches, La., one hundred ten miles distant, offered $150.00 to anyone who would bring the instruments to Nacogdoches within four days. (*3*) A young clerk in the General Land Office at Nacogdoches, by the name of Bennett Blake, undertook the journey. He accomplished his mission in three and one-half days and was paid the sum promised. Some years later, Blake participated in a two-day battle with Cherokee Indians, in which he helped retrieve a sword given by General Sam Houston of San Jacinto fame to Bowles, an Indian chief. You may recall, Houston was a friend of the Indians and was given the name, "Raven."

Many a tree in Texas has been hacked or blazed to mark the boundary line as run by the pioneer surveyor. Surveyor Joseph A. Tivy, a native of Toronto, Canada, was surveying on the San Saba in 1837, when he was ordered by a Comanche chief not to mark any more trees along the "white man's line." (*4*) The surveyor just laughed as his party had pistols and rifles, and the Indians had only bows and arrows.

Visions of a wrecked camp, papers strewn about, and a smashed compass—not to mention a scalped surveyor—had an effect on the results of surveying in Texas. (*5*) In areas where Indians lived, it was customary for the surveyor to locate only two or three corners of the survey or league and compute the remaining sides. The accuracy of the work also suffered because of poor chaining. Leadership and resourcefulness were among the qualities which marked the best surveyors operating in Indian country. The surveying parties, by drawing the fire of hostile Indians, were the first line of defense of the weak colonists. The surveyors usually worked beyond the frontier and frequently were the first to encounter Indians bent on depredations and to spread the alarm among the settlers.

CAPTAIN BARLETT SIMS

Captain Barlett Sims, a surveyor, migrated to Texas in 1826, settled on the Brazos River, and several years later moved to Bastrop County. (*6*) In October 1846, Sims started on a surveying expedition to the Pedernales River. His party consisted of a nephew having the same name and two other men, Clark and Grant. While surveythrough some tall sedge grass, the surveyors were attacked by a party of Indians who had concealed themselves in the grass near the survey line. Sims and his men did not discover the Indians until they were among them. The Indians outnumbered the survey party fifty to four. There was little chance of escape as the surveyors were on foot. Young Sims was the first one attacked. He managed to shoot one Indian and knock another down with the breech of his gun before he was killed. The two chain carriers, Clark and Grant, were roped by the Indians and then shot to death with arrows. This left Captain Sims alone with the Indians. Stationed at the rear of the line with his compass, he was able to reach his horse and mount it. He had hardly done so when a large Indian seized the bridle and momentarily stopped the horse. Captain Sims had a small derringer, which he drew from his pocket, and shot the Indian through the neck. The Indian's jug-

ular vein was probably cut as Sim's clothes were covered with blood when he escaped.

SURVEYOR ERATH AND THE INDIANS

Captain George B. Erath, a well-known surveyor and Indian fighter, hailed from Vienna, Austria. (7) About June 1831, Erath entered Texas and settled in Robertson Colony where he ran a farm jointly with a Mr. Porter. He varied his occupation as a farmer by going on occasional surveying expeditions. Erath often came in conflict with Indians who were antagonistic —especially to those engaged in surveying their lands. At times, Erath found it impossible to survey because of Indian hostilities. Once he enlisted in a company commanded by John H. Moore and went on a warlike expedition. Erath later made a survey around the head-waters of San Gabriel River and Brushy Creek. One of his men, Lang, was killed in a fight with the Indians. Between putting in crops and surveying trips, Erath scouted for Indians. He fought at the Battle of San Jacinto in 1836 and then returned to his farm in Robertson County. He resumed his occupation of surveying, and again one of his men, Curtis, was killed in a fight with the Indians. Erath, as a surveyor, staked off the City of Waco. In one of his numerous Indian fights and in his hurry to reload his gun, Erath overcharged it and was knocked down by the recoil when he shot an Indian. One of his men, seeing Erath fall, rushed to his aid and inquired if he was hurt. "No," replied Captain Erath, "I'm not hurt, but you see my gun knocks down before and behind."

A TREE WAS HIS TOMBSTONE

During the summer of 1838, a surveying expedition composed of ten men went from Bastrop County up the Guadalupe River. (8) After reaching the place where they intended to start surveying and not seeing any sign of Indians, they neglected to take the customary precautions to guard against surprise. One old frontiersman in the party returned home because the others did not consider it necessary to stand guard at night and keep a good lookout in the daytime. He told his friends at Bastrop why he had left the surveyors and prophesied that none of the party would survive their trip. When the surveyors failed to return to the settlement, a party was organized to find them. The searching party accidently found the spot where the surveyors had been killed by the Indians. It appears that the surveyors had found a number of bee trees and had felled six or seven of the trees before they attempted to take the honey. At this point, they apparently were attacked by the Indians. The bee trees were not touched. The searching party found the skeletons of the surveyors. Only one of the skeletons could be identified, that of a young man by the name of Beatty. His skeleton was found lying at the root of a tree on which, with his pocket knife, he had carved his name. Beatty, mortally wounded and left for dead by the Indians, had revived sufficiently to carve his name upon his own tombstone before he died.

SURVEYORS AND INDIANS ON THE COLORADO

Captain John Harvey, a surveyor from Tennessee, came to Texas in 1834 and settled first in San Augustine County, then after a few years moved to Bastrop. (9) In June 1839, Harvey made a surveying trip with a party of ten men. They went up the Colorado River into Burnet County. The party encamped on the Colorado River and began surveying a number of tracts bordering on the river. They continued their work for several days without any excitement to interrupt their labors.

The Captain, being a brave but cautious man, had a guard out at night, even when there was no sign of Indians in the vicinity. He worked on the theory that when you least expect Indians, "there they are." Early one morning, just before daybreak, Captain Harvey was in the act of awakening his party when they were fired upon by a band of Indians. The Indians had crawled unnoticed to some small bushes close to camp. In the darkness, the Indians hit only a Mr. Burnet, whose arm was broken. This surprise attack threw the surveyors into confusion, but Captain Harvey soon

rallied them. He ordered his men to take to the woods and each to defend himself. The fight was on.

Indians cannot resist a fine horse, so one ventured from his position to capture a horse that was tied to a tree. The Indian was in the act of slashing the rope when three shots from the surveyors cut him down. In spite of the rapid fire from the guns of the surveyors, Indians ran to their fallen comrade and carried him out of firing range. The Indian chief then ordered a retreat.

As soon as the Indians retreated, Captain Harvey had his men fall in to see if any were wounded or missing. Three were missing. One of the men was found to have crossed the river. The other two men were so badly frightened that they had cleared the scene of action and had become lost. They tried to return to camp but met the retreating Indians who chased them across the Colorado River. The two scared surveyors hid in a deep gulch all day without water. They never found the surveying party but after eight days finally reached a settlement near the present city of Austin.

BRASHEAR FOOLS THE INDIANS

A very remarkable escape from a marauding band of Indians was made by a Mr. Brashear in Lavaca County in 1839. (*10*) He was a man who never took precautions against danger, yet was always calm and cool when it struck. Brashear had gone to Lavaca County for the purpose of locating lands and while in that vicinity boarded with Mr. Henseley, who lived on the fringe of a settlement. Although Henseley warned Brashear not to go out alone because the area was frequently visited by Indians, he often traveled singly and unarmed to examine lands as far as twenty miles from the settlement.

One morning Brashear was on a tract of land and busily at work tracing a line with a pocket compass. As he turned a point of post oak timber, he discovered about twenty Comanche Indians, mounted upon their mustangs, nearly a quarter of a mile distant.

The Indians soon spotted the surveyor, gave the familiar war whoop, and went after him yelling and whooping like so many devils. Brashear later said he was not frightened, although unarmed, because he was confident his horse, Get Out, could easily outrun the Indians. He had traveled less than a mile toward the settlement when he found that the Indians were gaining on him. Something had to be done.

Brashear knew Boggy Creek could be crossed at only a few localities. He struck the creek 700 yards below a crossing and soon was hidden from view by a line of timber along the creek. His movements could not be seen by the Indians as he reached the ford, crossed it, and rode down the creek until he was about opposite the place where the Indians had lost sight of him.

Brashear had hardly reached this point when the Indians made their appearance. Seeing Brashear riding off, they naturally supposed he had crossed there. The Indians, without halting, plunged into the creek, and immediately their horses went down to their necks in the quicksand. Brashear could not resist crowing over the Indians, which made them furious. The surveyor gave them some expressive pantomine and leisurely rode away while the Indians extricated their horses from old Boggy Creek.

FIRST SETTLER WEST OF COLORADO

Major James Kerr, appointed surveyor general of Green DeWitt's Colony, arrived at the present site of Gonzales in July 1825. He was the first American settler (head of a family) to locate west of the Colorado River in Texas. As Major Kerr pursued his profession, his party subsisted on wild meat and coffee. One of his rodmen or chainmen was Deaf Smith of San Jacinto fame. In an Indian fight, one of Kerr's party, John Wightman, was scalped, and the camp house was robbed of its contents, including Major Kerr's field notes, sketches, and three surveying compasses. (*11*)

BATTLE CREEK FIGHT

Old Franklin (*12*), the county seat of the original Robertson County, was located between the present towns of Calvert and Bryan. It was a rendezvous for both surveying parties and volunteers for expeditions against the Indians. Discharged soldiers of the Texas Revolution and other citizens who had just received bounty and headright land certificates wanted their land located and surveyed. The land abounded in wild game and buffalo. Naturally the Indians, who depended on buffalo meat and hides, were hostile to surveying parties. (*13*)

Early in October 1838, William F. Henderson, of Corsicana, organized a surveying party to locate lands in the southwest portion of Navarro County. The entire party consisted of twenty-six men and one boy and was under the command of Captain J. Neill. Henderson and his assistant surveyor each had a compass.

Upon arrival at a water hole, afterwards known as Battle Creek, the party was met by Kickapoo Indians who professed friendship. These Indians had roamed off their reservation in Arkansas to lay in their supply of dried buffalo meat. A number of them spoke English. The surveyors camped near the Indians for several days. (14) The day after their arrival, the surveyors ran several lines, partly in timber and partly on the prairie. When work was commenced on the second day, it was discovered that one of the compass needles had lost its magnetism and would not swing to the north. William M. Love and William Jackson were dispatched back to Parker's Fort to obtain a magnet to recharge the needle. Before breakfast the next day, Henderson ran a line for a mile or so. While the work was progressing, the Indians were seen moving to and fro and following the survey line.

About eleven o'clock, the surveyors had breakfast on a spring branch. About fifty Kickapoos were seen across the branch. The Kickapoo chief came over to the surveyors to report that the Ionies and Comanches were on their way to kill the surveyors because those tribes did not want their lands surveyed. The surveying party was advised to leave the area. Although the surveyors were not afraid, they asked help from the Kickapoos in case of an attack but were refused, as the Indian tribes were bound by a treaty. The Kickapoos begged the party to leave, but the surveyors refused, and the Indians promised them a surprise.

The surveyors, resuming work, ran a mile of line into the prairie. As they were marking the corner, twelve Indians passed, and one of them questioned in English, "Is that a mile?" Another Indian pointed to Henderson's compass and exclaimed, "It that God's Eye?" The surveyors then ran a line parallel to a ravine about 200 feet distant. The surveyors did not suspect any danger. An Indian who had just begged some tobacco from Walter P. Lane shook hands with him and crossed the ravine. As the surveying party traversed the deep ravine which cut across the line, about forty Kickapoos arose from the ravine and fired upon the surveyors. Some of the horses were killed, and a number of the men were wounded. The surveyors hastily gathered up their instruments and fell back about a mile to the nearest timber.

They were surprised to find Indians there and took shelter at the junction of two ravines in the prairie, where a lone cottonwood stood. The surveyors found partial cover and concealment behind the small bushes growing at the top of the ravines. About 250 feet below their position was a mott* and water, but the Indians held this area. The Indians climbed the trees and fired into the surveyors' position.

From time to time, both surveyors and Indians felt the sting of lead and dropped from the fight. Euclid Cox, who had placed himself behind the cottonwood for an advantageous position, killed about ten Indians before he was shot through the spine. He died within two hours. When Cox fell, the Indians charged the surveyors' position but were driven back by a deadly fire from rifles and pistols. The battle lasted all afternoon and into the night. Several surveyors

* A clump of trees in a prairie.

had been killed and some badly wounded.

The surveyors anxiously awaited darkness so that an escape could be made. Night brought a full moon. As clouds failed to cover the moon, the surveyors made a midnight break for Richmond Creek bottom. The Indians, who had not been taken by surprise, poured hot shot into the party as they came out of the ravine. As the men retreated step by step, firing as they moved, the Indians were held in check. Four wounded surveyors on horseback were shot off. Other wounded took their places.

Upon approaching the cover of the woods, Captain Neill was wounded through the hips and placed on a horse behind another wounded man. Within a step, both were shot down together. Lane was shot through the calf of the leg, severing the leaders that connected the toes. Surveyor Henderson bandaged the wound within range of fifty Indians who could not see the surveyors for the shade. The surveyors of the party who survived the fight experienced many hardships before they reached the settlements. Lane and Henderson were met a couple of days later by Love and Jackson, the men who left the surveying party six days previous to the fight to get a magnet.

Historians differ as to the number of surveyors in this battle, which is referred to in Texas history as the Surveyors' Fight or the Battle Creek Fight. Probably eighteen were killed, seven escaped, and two were absent. The Indians lost at least twice as many men. After the Civil War, a farmer, ploughing on the site of the fight, found a compass with the name of William F. Henderson engraved on it. The compass was returned to the surveyor's son, Harry McCorry Henderson.

It should be pointed out that the Kickapoo Indians were essentially friendly toward the surveyors until they found that, after the land had been surveyed, white people would soon settle there and destroy their hunting grounds. The Indians considered the white man had no right to settle on their lands, and therefore they made war on the surveyors. The Kickapoos decided to kill the surveyors, expecting that this would discourage others from entering that part of the country.

THE BATTLE OF RICHMOND CREEK

During 1838, Sparks, Barry, and Holland, who belonged to a surveying party, were killed by Indians on the south side of Richmond Creek (*15*), twelve miles from the present city of Corsicana. Others of the party escaped by running away. The Indians placed themselves in ambush near the line the surveyors were running. Richard Sparks was a well-known land surveyor from Nacogdoches and his name as surveyor is signed to many land titles in that part of Texas. The three surveyors killed by the Indians were never buried as there were no friendly hands to administer the last rites. Some of their surveying instruments were found twelve years later at a point four miles south of Corsicana.

BIG FOOT WALLACE

William A. Wallace (*16*), better known as "Big Foot" Wallace, was a ranger, Indian fighter, and frontiersman, but not a surveyor. He deserves mention here because of his activities with a surveyor who was preparing for an expedition to locate lands upon the frontier of Texas. Quoting Wallace:

"At that time I was as green as a red blackberry and I frankly told the surveyor that I knew nothing about the woods or how to get along in them. But he said it made no difference, as the rest of the party were all old frontiersmen, and it was well enough to have one greenhorn along to make sport for the balance. Our party consisted of a guard of ten men, well armed and mounted, together with the surveyor, two chainmen, a marker, a hunter, a cook, making in all sixteen men—a sufficient force to travel with safety at that day, in the most dangerous part of the country."

CONCLUSION

A story of pioneer surveyors and their experiences with the Indians would not be complete without reciting a part of A. G. Farmer's poem "The Surveyors of Yesteryears." (*17*)

"The Indians claimed this hunting ground, the buffalo and the deer,
And opposed with all their might the coming of the pioneer.

Hats off to old surveyor, who ran these frontier lines
For the Texas Pioneer during these perilous Indian times.

★ ★ ★ ★ ★

"Chide not this old surveyor, who in his hurried way,
Hastily marked the corners we are hunting for today,
For he had many handicaps and very little help,
And he knew not when the Indians would try to take his scalp."

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(2) Wilbarger, J. W.: "Indian Depredations in Texas," Hutching Printing House, Austin, Texas, 1889 Reprint by The Steck Company, Austin, Texas, 1935, p. 382.

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(9) ———: *ibid.*, p. 263.

(10) ———: *ibid.*, p. 107.

(11) Brown, John Henry: *op. cit.* (3), p. 15.

(12) ———: *ibid.*, p. 47.

(13) Henderson, H. Mc.: "The Surveyors' Fight," *S. W. Historical Quarterly*, Vol. LVI, July, 1952.

(14) Wilbarger, J. W.: *op. cit.* (2), p. 352.

(15) ———: *ibid.*, p. 360.

(16) Freeman, J. D.: "The Early Surveyors of Texas," Report of Fourth Texas Surveyors' Short Course Conference, Austin, Texas, October 1948, p. 40.

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See also:

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Boothe, Zilmon J., Jr.: "Fee Ownership Mapping in Texas," *Surveying and Mapping*, Vol. VIII, No. 4, October–December 1948, p. 232.

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General Assembly of PAIGH

The General Assembly of the Pan American Institute of Geography and History was held at the University of Mexico, Mexico City, from July 25 to August 6, 1955, with an attendance of approximately 400 delegates and observers from the 21 American Republics. Several European countries also sent one or more delegates or observers.

The Commission on Cartography, which was holding its VII Consultation, is composed of nine committees—Geodesy, Gravimetry and Geomagnetism, Seismology, Topographic Maps and Aerophotogrammetry, Aeronautical Charts, Hydrography, Tides, Special Maps, and Urban Surveys. Each of these committees held from four to seven scientific sessions, with one or more sessions used to discuss new instruments, new materials, and new or improved methods of operation. Other subjects which were discussed included geodetic measurements of very high accuracy, 1:300,000 or better; calculation of long distances and the measurement of such by electronic methods; adjustment of trilateration surveys; gravimetric calibration networks and the value of extending these networks to cover the gravity range of the world; aerial and geomagnetic surveys (land and sea); seismograph stations in isolated and distant locations (such as Antarctica); standardization of cartographic symbols; progress in compilation of American geographic names; types of charts required for modern aeronavigation; Hydrographic Office requirements of a country with a definite maritime interest; Pan American tidal plan and the standardization of basic tidal stations; new national atlases of the American nations; and fundamental characteristics of new cadastral laws now in effect in the American countries.

The evenings were crowded with receptions and other social activities. Several interesting excursions were available to delegates and their guests during the week ends. There was an extensive program for family guests who were given splendid opportunities to visit the various points of interest in the city and surrounding country.

An Electronic Computer for Survey Problems

By CLARENCE W. KITCHENS, SR.

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THIS PAPER[1] describes the Experimental Service Test Model Electronic Survey Computer, designed to compute automatically problems encountered in normal survey operations. The computer was developed for the Surveying Branch, Topographic Engineering Department, The Engineer Research and Development Laboratories, Fort Belvoir, Virginia, by Monrobot Laboratory, a subsidiary of the Monroe Calculating Machine Company, Morris Plains, New Jersey, under an approved Corps of Engineers development project.

The Laboratories were requested by Army Field Forces and the Corps of Engineers to develop an electro-mechanical or electronic computer which would contain the sine and cosine as basic computer operations and which would solve the traverse problem automatically. The military characteristics for such a computer were prepared and presented to leading manufacturers interested in this type of development. The International Business Machines Corporation fabricated the first experimental model computer for these Laboratories in 1949 (See Figure 1). This computer was displayed before the American Geophysical Union in April 1949.

In procuring the service test model, the Laboratories again contacted all manufacturers who had indicated an interest in this development, and a contract was awarded to Monrobot Laboratory for the development of an electronic survey computer that would meet all requirements as specified in the revised military characteristics which were expanded to include means of solving such problems as:

Traverse computations
Triangle computations
Position computations
Conversion of geographic coordinates to UTM grid coordinates
Determinations of spherical excess
Trig-traverse problems
Three-point problem
Computation of azimuth, direction method
Trigonometric determinations of elevations
Geodetic adjustment of trilateration
Least-squares adjustments

This machine, referred to by the manufacturer as MONROBOT V, (*See* Figure 2), is a general-purpose sequence-controlled computer having 20 decimal-digit capacity with the decimal fixed centrally, between the tenth and eleventh digits. Any problem that can be solved by numerical methods can be programmed for solution by this computer. Computation is automatic and results are printed (or punched on tape) by a high-speed electric typing machine, known by the trade name "Flexowriter."

One of the most important features of this computer is its simplicity. Since both numbers and commands utilize the familiar decimal system there is no need for training an operator in binary arithmetic. Since the machine handles 20-digit numbers, the difficulties of scaling and of preventing overflow are largely eliminated. Numbers and orders may be conveniently entered on a simple keyboard and the computer is controlled by a minimum number of manual controls. The computer commands are inserted as the algebraic statement of the problem to be solved. Even a novice operator finds it possible to program problems after the first day's acquaintance with the input keyboard.

Presented at the Fifteenth Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 9–11, 1955.

[1] This article represents only the views of the writer and not necessarily the official views and policies of the Corps of Engineers or the Department of the Army.

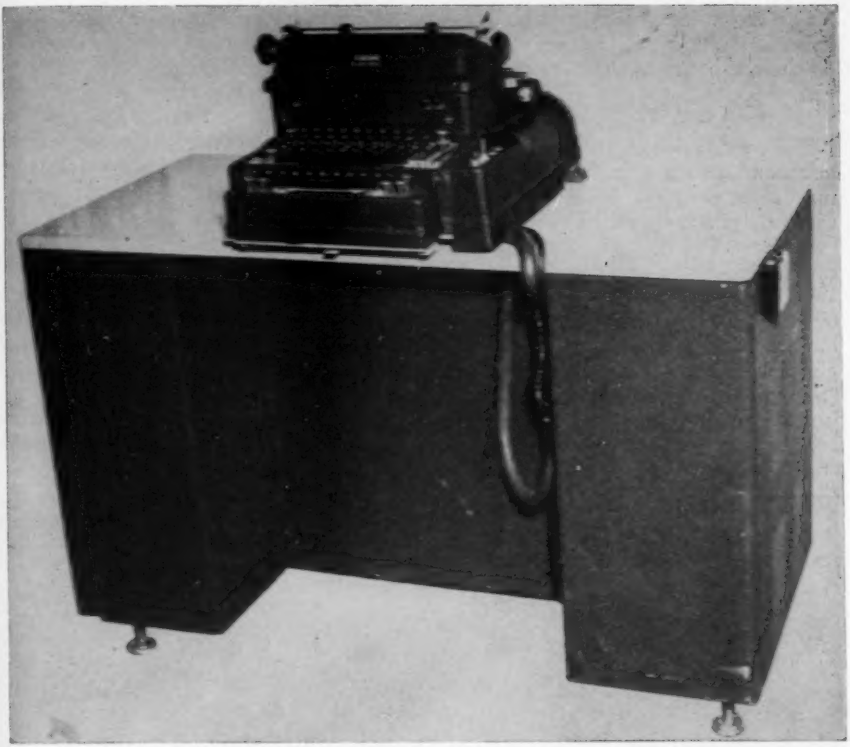

FIGURE 1.—This electro-mechanical computer was the first experimental model survey computer developed for ERDL. Upon entering azimuth and distance into the electric typewriter, the sine and cosine functions are automatically searched to 6-place accuracy. The required computations are performed and recorded automatically on a survey form in 8 to 10 seconds of time. The typewriter has an auxiliary numerical keyboard for inserting field data.

Other important features are economy of maintenance and compactness. Many check points and a nominal number of plug-in packages facilitate maintenance. The computer is 72 inches long, 47 inches wide, and 30 inches high (equivalent to the size of a large office desk) and weighs 1686 pounds. It is shock mounted to facilitate transport in a Mobile Control Section or other vehicles and can be readily separated into two units for easy handling in transport or movement through narrow doorways.

DESIGN

Since the computer is designed to insure maximum reliability, a conservative approach is evident throughout. The initial power application is controlled by Variac so as to provide gradual filament warmup and hence increase life expectancy of the tubes and components. The shutoff procedure is similarly controlled. The tubes, resistors, and other components are operated at far below their recommended ratings and thus achieve proportionally increased life expectancy.

The pulse rate (10 kc) and pulse density (10 per inch) permit the use of simple and reliable components and provide a wide margin of safety. The computer contains approximately 700 logic elements (tubes, diodes). The magnetic drum is 20 inches

long, 6 inches in diameter, and rotates at a speed of 3600 r.p.m., retaining the data despite computer shutdown or power failures.

CONSTRUCTION

The construction of both the major elements and circuits is unitized; that is, malfunctioning parts may be replaced as units without significantly interrupting computer operation. Twelve basic plug-in units are employed in the electronic circuits, and these are arranged in individually accessible racks. Similarly, larger components such as the magnetic drum are both accessible and replaceable. The vacuum tubes are of the "rugged-reliable" type, having a guaranteed long life expectancy under severe conditions.

The power requirements for the computer are 105–120 volts, single phase, 50–60 cycle, a.c., and power consumption is 5 kv-a. The computer is provided with overload and other protective devices.

Various safety features built into the computer check on both operator and computer. In addition, marginal checking facilities are available and permit adequate preventive maintenance.

STORAGE SYSTEM

The computer has magnetic-drum storage facilities which can record a maximum of 100 twenty-eight decimal numbers with algebraic sign, and 200 operational orders. Both orders and numbers remain undisturbed in storage unless they are deliberately erased or replaced. Such changes may be made via the keyboard, or occur automatically during a calculation process.

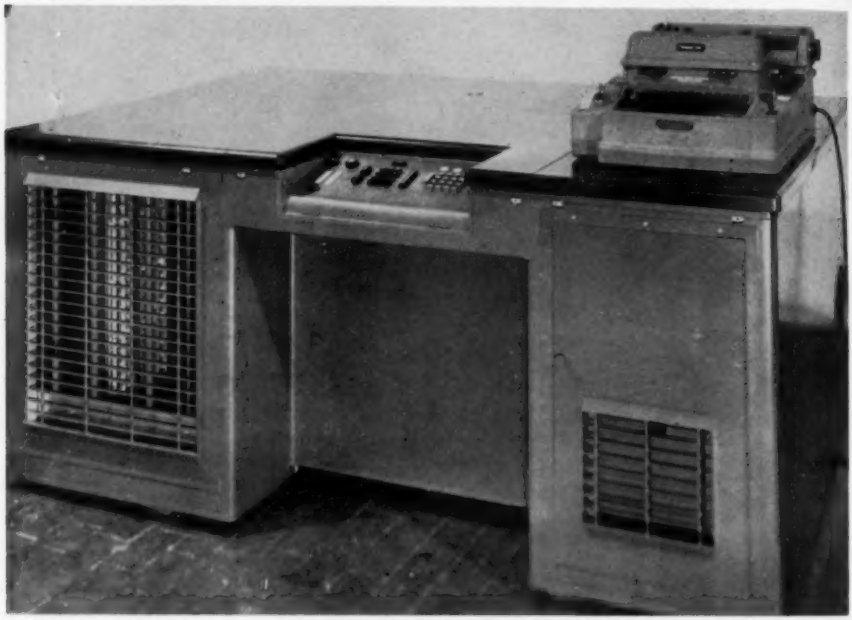

FIGURE 2.—Electronic survey computer mounted in a desk type structure 44½ by 72 by 31 inches. The electronic computer is controlled by the keyboard shown in the center. Program tapes are provided for the various types of survey problems. As the basic data are entered, the computer automatically performs the computations, with the results printed by the Flexowriter shown on the right. Numbers and program orders may be entered into the calculator at an approximate rate of ten digits per second. Tape readings are an automatic function under control of the calculator.

Designation of Numbers Locations

The location of each number in storage is designated by a symbol called the number address. The symbols range from a0 through k9, using the ten alphabetic letters

a, b, c, . . . , k

(the letter i being omitted to avoid confusion with the numeral 1), and the ten decimal digits

0, 1, 2, . . . , 9

The letters a, b, . . . , k correspond to decimal digits so that the first ten storage locations are

a0, a1, a2, . . . , a9,

the next ten are

b0, b1, b2, . . . , b9,

and so forth. Every number used in programming and calculation is assigned a number address, and no number can be used by the computer until it has first been submitted to the storage unit.

Designation of Order Locations

The location of each order is assigned a numerical symbol called the order address. The symbols range from 00 to 99 inclusive. Two modes of 100 orders each are available. In general, orders are used sequentially, starting with the order in location 00 and progressing through the integers 01, 02, 03, etc.

ORDERS—PROGRAMMING BASIC OPERATIONS

An order consists of five elements: four addresses, A, B, C, and D, and an operation, OP. The addresses specify number and order storage locations. The operation, OP, may be any one of twelve basic operations which the computer is capable of performing. They are:

(1) Addition
(2) Subtraction
(3) Multiplication
(4) Division
(5) Comparison for inequality
(6) Comparison for equality
(7) Modification
(8) Print
(9) Print-stop
(10) Stop
(11) Read numbers (from perforated tape)
(12) Read orders (from perforated tape)

Operations (5), (6), and (7) are special operations that facilitate programming, and operations (8), (9), and (10) are operations controlling the printing of results (or storage contents) and termination of computation.

The elements of an order are arranged schematically as follows:

		A	B	C	D	OP
		A	B	C	D	OP
Line 2		Operand	Operand	Result	Next Order	Operation
	Order No.	A	B	C	D	OP
Line 3	36	a2	d3	e7	37	+

If OP is one of the operations (addition, subtraction, multiplication, or division) above, then A, B, C, and D are as shown in Line 2.

Addresses A and B specify the locations of the two numbers involved in the operation; address C specifies the storage location to which the resulting sum, difference, product, or quotient is sent; and address D informs the computer where it may find the next order. An example of an order of this type is shown in Line 3.

Order 36 directs the computer to add the contents of a2 and d3, and to place the result in storage at location e7; it then directs the computer to continue to order 37. The order may be stated briefly as follows: add (a2) and (d3), and store the result in e7; then go to order 37. In accordance with convention, parentheses are placed about a storage location to denote the contents of that location; thus (a0) is read: "the contents of storage location a0." In any order

involving one of the arithmetic operations (addition, subtraction, multiplication, or division), the result of the operation may be delivered to the storage location of one of the operands; it then replaces the former contents of that location.

The comparison or equality orders provide for conditional transfer of control so that the machine will perform iterative routines until convergence is reached and will then start performing other operations. Modification is useful in conserving orders when the same operation or sequence of operations is to be performed on several different operands. If, for example, it is desired to print out fifty of the numbers in storage, only one print order, one modify order and one control order are necessary. As each number is printed, the modify order automatically changes the address of the next number to be printed so that fifty distinct commands are not required.

BASIC TECHNIQUES

As an application of modification, consider the evaluation of the seventh-order polynomial,

$$f(x) = a_0x^7 + a_1x^6 + a_2x^5 + a_3x^4 + a_4x^3 + a_5x^2 + a_6x + a_7$$

The factored form,

$$f(x) = ((((((a_0x + a_1)x + a_2)x + a3) \ . \ . \ . \ x + a_6)x + a_7))$$

involves successive additions of the coefficients a_1 to a_7, and may be readily programmed by use of the modification order. Such a program is illustrated as follows:

EVALUATION OF $f(x)$

STORAGE ASSIGNMENT	NUMBER	STORAGE ASSIGNMENT	NUMBER
a0	a0	a6	a6
a1	a1	a7	a7
a2	a2	b0	x
a3	a3	c0	0.0
a4	a4	c1	1.0
a5	a5	c2	7.0

Start with Order 00 Date By

Order Number	A	B	C	D	Oper.	Operation Notes
00	a0	b0	a0	01	x	Coefficient times x
01	a0	a1	a0	02	+	Add next coefficient
02	c0	c1	c0	03	+	Count
03	c0	c2	04	06	=	Does count = 7.0?
04	01	05	01	00	Mod	Modify B address
05	00	01	00	00	+	To next coefficient
06	ao	ao	ss	ss	Print Stop	Print $f(x)$ and stop

By storing the coefficients in successive locations and modifying the B address of order 04, each coefficient in turn is added to the cumulative factors (a0). In most instances, once a program has been submitted to storage it will be used several times. Therefore, it is important not to destroy programmed orders by modifications.

ABSOLUTE MAGNITUDES

In each of the orders the arithmetic operation is normally carried out with consideration of algebraic sign. However, it is possible within the same operational command, to specify that the operation be performed using the absolute magnitude of either one or both operands, A and B, and/or that the absolute magnitude of the result be placed in storage at address C (the comparison order being excepted in the latter case). In an order of this type, the operation symbol is supplemented by the corresponding addresses A, B, or C.

Addition, subtraction, comparison, and modification are performed at a rate of 450 per minute, including access time, while multiplication and division are performed at a rate of 100 per minute. Printing proceeds at a rate of about 10 characters per second.

KEYBOARD

The computer keyboard (Figure 3) provides both number and order entry to specific storage locations. The keyboard keys also permit the selection of any stored program for consideration or a single order for test purposes. Computation may be manually halted at any time and a print-out command activated. Various indicator lights designate the operating status of the computer and afford visible program checks.

Digit-dropping switches permit the automatic dropping of a selected number of digits to the left and right of the printed decimal point. Non-significant zeros to the left of the point, except the first, are always dropped. Negative numbers are automatically printed in red. These features in conjunction with the typewriter tab stops permit the printing of data in columnar form as required for the particular survey problem being solved.

PROBLEMS FOR WHICH THE COMPUTER IS SUITED

The computer is a general-purpose device and hence capable of handling any problem suitable to its magnetic-storage and paper-tape capacity. In accordance with the contract, the Monrobot Laboratory prepared program tapes which specify numerous survey problems. To commence computation, the programmer would (1) insert the basic data obtained from field books either through the computer keyboard, or via punched tapes; (2) feed the proper program tape through the Flexowriter which in turn automatically passes the data to the computer for storage; (3) specify on the keyboard the order with which computation is to commence; and (4) depress the "CALCULATE" key.

The same problem could, of course, be repeated using different new data without resubmitting the program tape. The program remains undisturbed in storage unless replaced by another.

A list of problems that have been programmed and are available as separate tapes are:

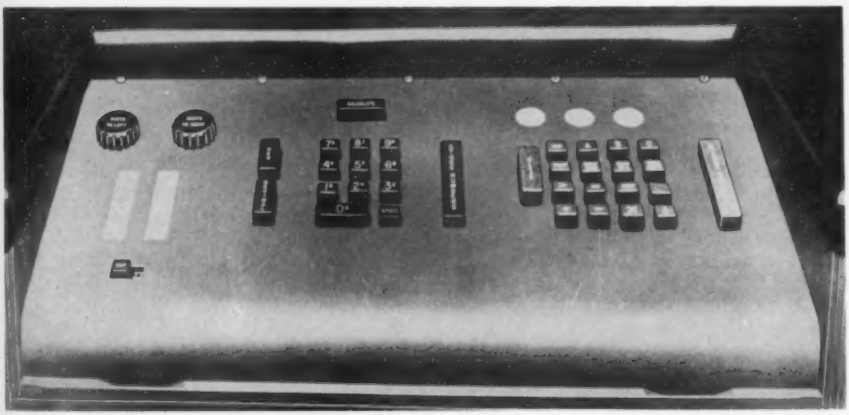

FIGURE 3.—The computer keyboard unit is about the size of a desk-top electric calculator and contains all controls necessary for operation of the equipment. It has a compact simply-arranged keyboard for high-speed entry of data, keys for starting and stopping calculations, and supervisory pilot lamps. Entry of digits with fixed decimal point is controlled by dials and read-outs on the left side of the keyboard.

	Time Required Using Conventional Methods	Time Required Using Electronic Computer
Sine and cosine routine	45 Seconds	18 Seconds
Tangent routine	———	18 Seconds
Arc sine, arc cosine, arc tangent	———	———
All root problems, such as square & cube root	———	———
Traverse computations	24 Minutes	2½ Minutes
Triangle computations	17 Minutes	2 Minutes
Position computations	41 Minutes	2 Minutes
Geographic to UTM grid coordinates	24 Minutes	15 Seconds
Spherical excess	15 Minutes	20 Seconds
Trig-traverse problem	3 Minutes	45 Seconds
Three-point problem	39 Minutes	1½ Minutes
Computation of azimuth, direction method	14 Minutes	2 Minutes
Trigonometric elevation	12 Minutes	45 Seconds
Geodetic adjustment of trilateration	———	———
Least squares adjustments	110 Minutes	———

The manufacturer is to be commended for having added to the computing field another fine instrument that permits survey computations to be obtained at greater speed and accuracy than that obtainable with our present equipment.

The Brock Award for Contributions to Photogrammetry

The International Society for Photogrammetry recently announced the establishment of a new award, to be known as the Brock Award, as a means of encouraging new developments and significant contributions to photogrammetry throughout the world. The award, consisting of a gold medal and a certificate of honor, has been provided by Virgil Kauffman, President of Aero Service Corp.

The award commemorates the original pioneering work, beginning in 1914, of a group of Philadelphians headed by Arthur Brock, Jr., and Norman Brock who conceived and developed the Brock Process and, in the early 1920's organized a company known as Brock and Weymouth, Inc., which produced the first accurate photogrammetric surveys in the United States and Canada. The Brock Process bears the distinction of being one of the great and earliest contributions to photogrammetry made by the United States.

At the request of the donor, the award is to be international in character and is to be administered by the Council of the International Society for Photogrammetry. The award is to be presented only in recognition of a landmark contribution to photogrammetry; a fundamentally new equipment or technique may be recognized, or a new departure or a major, completed photogrammetric mapping project. The award is to be made to an individual, not to a group or to a commercial organization.

The award is to be presented as often as and only when a contribution is so significant as to be an outstanding landmark in the progress of photogrammetry—except that not more than two awards shall be made in respect of any one congress and not more than five awards in any consecutive 20 years.

Recommendations for the award must be made in writing by two sponsors of different nationalities who shall be members of the ISP and not of the same nationality as the proposed recipient.

In order to allow time for consideration by the Council, recommendations for awards to be presented at the July 1956 meeting of the ISP in Stockholm must be received by January 1, 1956. They should be addressed to P. Mogensen, President, International Society for Photogrammetry, Föreningsvägen 23, Stockholm-Stocksund, Sweden.

Tax Maps for Maryland

By WM. L. SHOEMAKER

MARYLAND STATE TAX COMMISSION

TAX MAPS have been considered an important asset to an efficient property assessment program for quite a few years, but the means of producing satisfactory maps has seriously curtailed their use in most states. There have been some definite advances recently, however, including the program now underway in Maryland. Since my only contact with tax map work has been in Maryland, I will describe our program which is applicable to most areas in the country. Before discussing the features of tax maps, it may be well to point out the difference between a property map and a tax map. A property map, as the name implies, shows the relative positions of boundaries. A tax map, in addition to boundary lines, shows information specified by tax agencies to enable a coordinated and equitable property assessment to be made.

PREPARATION OF MAPS

The tax map program in Maryland started as a clause buried deep in a law passed in 1951 which read as follows: "To prepare and install for each county a complete record of properties and system of appraisal aids consisting of property location maps, land classification maps, and unit land value maps." Because the main portion of the law was aimed at revising the assessment porgram, the legislators neglected in the rush of business to appropriate any money for the tax map work.

During the following year the very able Secretary of the State Tax Commission, to whom the credit for the success of this program belongs, spent much of his time discussing the mapping project with various engineers and State officials. I became connected with the work during this period. Plans for an organization and a budget were set up which it was hoped could become effective in July, 1952, after the budget was approved. Fortunately, arrangements were made to secure a small sum from the Governor's contigent fund, so that work was begun in February, 1952.

It was evident that the project would be impossible without access to aerial photographs. Arrangements were made, therefore, with the Department of Agriculture to have the State photographed. Next, it was necessary to compile a set of standard base maps on which the property lines could be drawn. I have always felt that these base maps should have been made photogrammetrically with maximum precision, with the various State agencies contributing to their cost. The State Tax Commission was charged with the task, however, and a cooperative effort was not feasible. The cost of precise maps could not be borne by our budget so it was necessary to prepare these maps by enlarging the best ones available.

All of the deeds necessary to describe the original tracts of land and the sales therefrom are being read in order to place property lines on the map. Each deed is plotted on separate sheets of paper and these are later pieced together by means of the aerial photographs. Of course it is necessary to constantly revise the maps, and it is expected they will be kept current within 60 days. Arrangements have been made with the Hall of Records to send a micro-film copy of every deed that is recorded.

Along with the mapping work, an index of ownership is being built. This is actually one index by name and another by parcel number. A parcel number is assigned to each property and will always remain the same regardless of the owner. With this index it is possible to find the location of any tract for which the owner is known, or vice versa. The index also includes the

Presented at the Fifteenth Annual Meeting of the American Congress on Surveying and Mapping. Washington, D. C., Mar. 9–11, 1955.

deed reference and will show a history of the title from July, 1952. The indexing system will be particularly adaptable to electrical accounting equipment if that becomes feasible.

COST AND ECONOMIC VALUE

Copies of the map are furnished free to State and local agencies and are sold to the public at 50 cents per map to cover the cost of printing, postage, and handling. It is not possible to sell the maps at a profit to help offset the cost of compilation. Thus far no attenmpt has been made to widely publicize the availability of the maps because numerous requests would handicap us. When knowledge of their existence becomes widespread, it may take two full-time employees to handle the reproduction and other information services.

The project will cost the State in the neighborhood of one million dollars and about $75,000 per year thereafter to keep the maps current.

The maps are primarily for use in assesment procedures, and I would hesitate to set the value in terms of dollars and cents. We have reason to believe, however, that the cost of preparation can be recovered by the State Tax Commission in ten to twelve years.

Maps can be applied to each of the three basic operations of the assessment agencies. First is the discovery of property. There will be no untaxed or escaped property, and the correct area of land charged to each owner will be a certainty. Secondly, the maps will aid in the description of property on the assessment roll. This description (not to be confused with the deed description) usually is confined to adjoining physical features, adjoining owners, and parcel number. Third, it will enable the assessor to consider the land use and potential value of each property in relation to the surrounding area. The equitable appraisal which these maps permit will be of tremendous importance to the assessment agencies as well as to the taxpayers themselves. A taxpayer will be able to see what his share of the tax burden is in relation to his neighbors'. The history of most tax appeals indicates that a taxpayer is more interested in paying only his share, rather than how much he pays.

I will point out just one of the problems of assessors that these maps can solve—that is, locating and assessing new buildings that are indicated by the building permit records. Now it will be possible for the agency issuing the building permits to reference each building to the parcel number on the map. Location of that building in the field requires only the ability to read a map.

AIDS TO HIGHWAY DEPARTMENTS

Aside from the value of these maps to the Tax Commission, they can be used by the right-of-way and location divisions of the State and county highway departments. Since our maps are based on the State Plane Coordinate System, proposed routes can be plotted readily on the maps as a standard procedure if and when the highway departments realize the value of State Coordinate surveys. When the route is plotted on a map it is apparent which property is affected, and whether or not the route should be altered to affect less valuable property. It is possible that these maps will be more valuable to the State Roads Commission than to any other single agency. The Commission has already used these maps to a certain extent, and, although no comments have been heard regarding their use, the requests for prints are becoming more frequent. Evidently they are being used to advantage. The same application can be made in laying out transmission or pipeline rights-of-way. They are of great value to planning and zoning departments as well as to Forestry, Park, Police, and Fire departments. Such maps have been sold to a concern drilling for gas in one county and it was very enthusiastic about them.

As to the effect of these maps on land surveying, it can be said that some surveyors, not too familiar with the project, believe that tax maps are infringing on their profession. This certainly is not true, because a tax map is not a legal plat. As a matter of fact, tax maps should increase

the work of the surveyor. One man in Maryland became interested in a tax map of his woodland tract, thought a wrong boundary was shown, and engaged a surveyor whose fee promises to be more than the tract of land is worth.

Although the Tax Commission has no authority to become a form of land registration office, it has collected such a volume of information that if land registration becomes a reality much of the basic research will already have been done.

TIES TO STATE COORDINATES

There has been a great deal of discussion in the Property Surveys Division of the Congress about ties to State coordinates. In connection with this matter, I intend to show survey markers on the tax maps, hoping that it will induce some surveyors to tie to those markers. Property descriptions have always appeared to me to be exceptionally vague in relation to the general location. The metes and bounds may be perfect, but the information concerning the general location may be confined to the fact that the property fronts on a road between two distant points, or may even be missing altogether. By using tax maps it may be possible to scale the approximate coordinates of the center of the property and include them in the description to locate the tract of land the metes-and-bounds description encloses.

The field of tax map work is certainly in its infancy, and, although certain methods of map preparation are fairly evident, much can be learned from the work in a particular locality. There are many aids and shortcuts to be uncovered, but the most important thing to remember is that this mapping is not expensive. In many cases, tax map projects are presumed to be expensive because only the value to the assessment agencies is considered and because it is assumed that the program must be 100% complete before it can be used. When this program was just started, I talked to several engineers about the work involved. Some of them said it was impossible; some said it was a waste of time and money; and some just shook their heads in silence. Not one person who has seen or used one of the tax maps has failed to make a comment such as—"Why wasn't this done years ago?" That reaction is an adequate testimonial to the effectiveness of tax maps.

Plane Coordinate Intersection Tables

The recent announcement by the Coast and Geodetic Survey of the publication of plane coordinate intersection tables for more States brings to twenty-two the number of States now covered. The States included in recent announcements are New York, Indiana, New Jersey, Texas, Ohio, Nevada, and Washington (Special Publication Nos. 328, 332, 333, 335, 336, 337, and 338). A complete list of those previously published will be found in SURVEYING AND MAPPING, April–June 1955, page 222. These publications are a part of a series which will ultimately include all States.

The tables will be of value to the surveyor and mapper in that, through their use, meridians and parallels with 2½-minute intervals may be placed on maps and surveys based on a rectangular grid of the State plane coordinate system, or the grid lines may be placed on maps constructed on a State system of meridians and parallels. Also, approximate values of plane coordinates of geographic positions may be obtained by interpolation within the tables.

Copies of these publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at the following prices: No. 328, 60 cents; No. 332, 50 cents; No. 333, 25 cents; No. 335, $1.75; No. 336, 45 cents; No. 337, $1.00; and No. 338, 65 cents.

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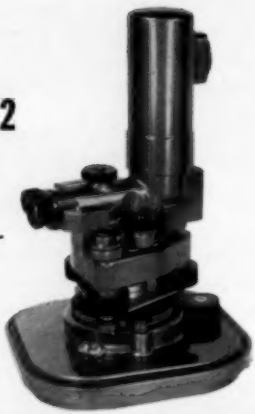

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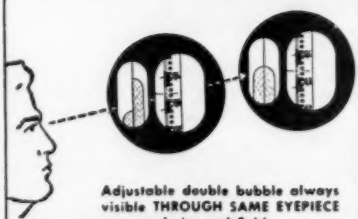

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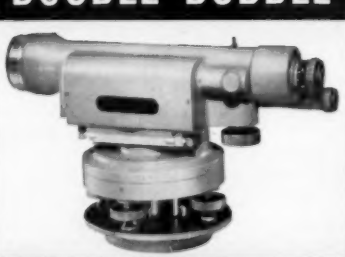

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CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

General Interest

HISTORICAL NOTES ON RESEARCH IN THE USE OF AIR PHOTOGRAPHS FOR FORESTRY. H. E. Seely. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Paper presented at the Annual Meeting of the Canadian Institute of Surveying and Photogrammetry, held in Ottawa, February 1955.)

THE ACTIVITIES OF THE PAN-AMERICAN INSTITUTE OF GEOGRAPHY AND HISTORY. Dr. Andre C. Simonpietri. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Paper presented at the Annual Meeting of the Canadian Institute of Surveying and Photogrammetry, held in Ottawa, February 1955.)

ELECTRONICS IN SURVEYING AND PHOTOGRAMMETRY. Sir Robert Watson-Watt. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Paper presented at the Annual Meeting of the Canadian Institute of Surveying and Photogrammetry, held in Ottawa, February 1955.)

PRESERVATION OF SURVEY MARKS. (Editorial) *The Australian Surveyor,* Vol. 15, No. 6, June 1955. (Brief comment on an important topic.)

THE BOUNDARY WATERS TREATY AND THE COLUMBIA RIVER INVESTIGATION. T. M. Patterson. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Provides an insight into the problems involved in the question of rights to Columbia River waters and other matters being worked out by an international commission.)

PHOTOGRAMMETRIC VOLUME DETERMINATION OF HUGE PULPWOOD PILES. Harold E. Young. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Further discussion of application of photogrammetric methods to forest management.)

THE CORPS OF ENGINEERS 1775–1955. (Unsigned article) *The Military Engineer,* Vol. 47, No. 318, July–August 1955. (Brief history of the Corps and its many achievements.)

Control Surveys

SHORAN CONTROLLED PHOTOGRAPHY. Manuel A. Silva. *The Engineering Journal* (The Journal of the Engineering Institute of Canada), Vol. 38, No. 3, March 1955. (Describes season's operation in which 11,000 lineal miles of Shoran controlled aerial photography were completed.)

OPERATING PRINCIPLES OF LORAN. (Staff article) *The Ships' Bulletin,* Vol. 35, No. 2, March–April 1955. (General discussion primarily slanted to use of system in marine navigation but applicable to its utilization in geodetic surveying.)

AIRBORNE TARGET TRIANGULATION. C. H. Ney. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Technical discussion of an experimental method of field triangulation.)

INTERCONTINENTAL CONNECTION OF GEODETIC SYSTEMS. W. A. Heiskanen. *The International Hydrographic Review,* Vol. 32, No. 1, May 1955. (Technical discussion of the progress made in solving the problems involved.)

PRECISE SURVEYS FOR THE MILITARY. Lt. Commander Don A. Jones, U. S. C. & G. S. *The Military Engineer,* Vol. 47, No. 317, May–June 1955. (A summary of special survey operations conducted by the Coast and Geodetic Survey during and since 1942 in support of military activities.)

AERODROME OBSTRUCTION SURVEYS. F. C. Petts and H. Kading. *Empire Survey Review,* Vol. 13, No. 97, July 1955. (States origin and nature of performance requirements governing operation of civil transport aircraft and describes a survey technique, a particular application of terrestrial photogrammetry, which has been used to meet the problem.)

TRAVERSE REDUCTION WITH AN ELECTRONIC DIGITAL COMPUTER. J. M. Bennett and H. Cotton. *Empire Survey Review,* Vol. 13, No. 97, July 1955. (Describes work carried out by the authors on the Manchester Universal Digital Computer at Manchester University.)

LATITUDE, LONGITUDE AND AZIMUTH FROM TWO STARS. G. J. Thornton-Smith. *Empire Survey Review,* Vol. 13, No. 97, July 1955. (Discusses a special type of astronomical observation and formulae for reduction of the results are derived and applied to an example.)

THE REJECTION OF OUTLYING OBSERVATIONS. Dr. W. R. Logan. *Empire Survey Review,* Vol. 13, No. 97, July 1955. (Explanation of how the mathematical theory of statistics may be applied to measurements made in surveying.)

Cartography

A NEW METHOD FOR THE DETERMINATION OF THE DISTORTION AND THE INNER ORIENTATION OF CAMERAS AND PROJECTORS. Bertil Hallert. Photogrammetria, 1954–1955, No. 3. (Mathematical analysis of the method.)

UNITED NATIONS REGIONAL CARTOGRAPHIC CONFERENCE FOR ASIA AND THE FAR EAST. W. Schermerhorn. *Photogrammetria,* 1954–1955, No. 3. (Summary of the results of the conference held at Mussoorie, India, February 15–25, 1955.)

PERFECTION IN TOPOGRAPHIC MAPPING—WHEN IS IT JUSTIFIED? Leon T. Eliel. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Contends that in some instances the highest standard of accuracy is not required while in others the utmost perfection is desirable.)

PRINTING AIDS TO THE MAPPER AND SURVEYOR. H. B. Carver. *Journal, Florida Engineering Society,* Vol. 8, No. 6, April 1955. (Basic discussion by a professional printer of the services available to local surveyors and mappers.)

RECENT UNITED STATES PROGRESS AND INTERESTING TECHNICAL DEVELOPMENTS IN CARTOGRAPHY. Presented by the United States Representative to the United Nations Cartographic Conference for Asia and the Far East, Mussoorie, India, February 15–28, 1955. *The International Hydrographic Review,* Vol. 32, No. 1, May 1955. (Summary of recent developments.)

HYDROGRAPHIC SURVEYS: THE PURPOSE AND THE CHOICE OF SCALE. Vice-Admiral Sir Archibald Day. *The International Hydrographic Review,* Vol. 32, No. 1, May 1955. (Reproduced from the Journal of the Royal Institution of Chartered Surveyors for March 1954.)

GENERAL BATHYMETRIC CHART OF THE OCEANS. I. H. B. Circular Letter No. 4-H of 1955. *The International Hydrographic Review,* Vol. 32, No. 1, May 1955. (Presents standards recommended by the International Committee on the Nomenclature of Ocean Bottom Features.)

THE STORAGE AND CONSERVATION OF MAPS. A report prepared by a committee of the Royal Geographical Society, 1954. *The Geographical Journal,* Vol. 121, Part 2, June 1955. (The purpose of the committee was to draw up ideal standards of map conservation for the guidance of map curators.)

THE GENERAL BATHYMETRIC CHART OF THE OCEANS. John D. H. Wiseman and Cameron D. Ovey. *Deep-Sea Research,* Vol. 2, No. 4, July 1955. (A brief historical account of the chart and its various editions with a summary of suggestions for its improvement as well as an invitation for criticisms and suggestions.)

ONE YEAR TO AIR-SURVEY RUSSIA. (Staff article). *Aviation Week,* Vol. 63, No. 6, August 8, 1955. (Sherman M. Fairchild's comments on challenge to aerial photographers posed by President Eisenhower's Geneva suggestion that U. S. and Russia conduct aerial reconnaissance of each other's military establishments.)

Topography

HELICOPTER REVOLUTIONIZES TOPOGRAPHIC MAPPING OF REMOTE AREAS. Gerald FitzGerald. *Civil Engineering,* Vol. 24, No. 12, December 1954. (Describes utilization of helicopters by U. S. Geological Survey. Reprinted in SURVEYING AND MAPPING, Vol. XV, No. 1, January–March 1955.)

TOPOGRAPHICAL SURVEYS OF THE COLUMBIA RIVER BASIN. D. R. Slessor. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Detailed account of a difficult survey operation in the Canadian portion of the Columbia Basin to provide mapping in connection with an international commission study to determine if a better use could be made of the waters of the river.)

HIGHWAY WIDENING JOB—PHOTOGRAMMETRY SPEEDS START. (Staff article) *Engineering News-Record,* Vol. 155, No. 5, August 4, 1955. (Describes how use of photogrammetry to map a strip of rough terrain saved time and money on an important Pennsylvania highway project.)

Property Surveys

LARGE SCALE PHOTOGRAMMETRY AND ECONOMY OF PRECISION PHOTOGRAMMETRY IN SWITZERLAND. A Pastorelli. *Photogrammetria,* 1954–1955, No. 3. (General discussion of photogrammetric operations in Switzerland with special reference to cadastral surveys.)

NOTES ON SURVEYING. L. C. Higbee. *The Canadian Surveyor,* Vol. 12, No. 7, April 1955. (Views of the president of ACSM as presented to the Canadian Institute of Surveying and Photogrammetry.)

AM I A SURVEYOR? H. O. Peters. *Journal, Florida Engineering Society,* Vol. 8, No. 6,

April 1955. (Outlines the necessary professional requirements to distinguish real land surveyors from mere "instrument men".)

STATE RECTANGULAR CO-ORDINATE SYSTEMS. Colonel L. Fitzgerald. *The Australian Surveyor,* Vol. 15, No. 6, June 1955. (Discussion of development of systems in Australia, citing examples from the United States.)

NOTES ON THE POSITION LINE. B. Chiat. *Empire Survey Review,* Vol. 13, No. 97, July 1955. (Notes on the simultaneous determination of latitude and longitude by the position-line method.)

COORDINATE SYSTEMS AND THE THREE POINT PROBLEM. H. Klinkenberg. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Mathematical discussion to demonstrate the advantages of a plane-coordinate system.)

A CONVENIENT METHOD OF CUTTING OFF A TRAPEZIUM OF REQUIRED AREA FROM A LARGER FOUR-SIDED FIGURE. A. I. Bereskin. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Mathematical discussion of method as applied to surveys of mineral claims as well as other property.)

LAND SURVEYING IN CANADA LANDS. D. R. Slessor. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (An outline of the work connected with Canadian federal land surveys.)

SURVEY AND DESCRIPTION OF CANADA LANDS. R. Thistlethwait. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Statement of guiding principles.)

LAND REGISTRATION IN CANADA. R. W. Bolstad and Eric Hardy of the Citizens Research Institute. *The Canadian Surveyor,* Vol. 12, No. 8, July 1955. (Sets forth the advantages of the Torrens system of establishing original title.)

SCATTERED TRACTS GO ON THE AUCTION BLOCK. Russel Kifer and Harold Tysk. *Our Public Lands,* Vol. 5, No. 3, July–August–September 1955. (Describes program of Bureau of Land management for disposing of non-contiguous areas of public land not required for public purposes.)

ANCIENT IRAQ TRIES RECTANGULAR SURVEYING. Clark L. Gumm. *Our Public Lands,* Vol. 5, No. 3, July–August–September 1955. (Author, during a two-year tour of duty in Iraq on loan from the Bureau of Land Management, introduces a rectangular survey system patterned after that in the United States.)

Education

GEOGRAPHY IN EDUCATION. A report prepared by the Education Committee of the Royal Geographical Society 1955. *The Geographical Journal,* Vol. 121, Part 2, June 1955. (Brings out the points that maps are the tools of geographers and that they should have a basic understanding of surveying and of survey methods.)

ENGINEERING EDUCATION IS *EVERY* ENGINEER'S BUSINESS. Harvey O. Banks. *Civil Engineering,* Vol. 25, No. 8, August 1955. (Abstract of paper presented at the ASCE San Diego Convention. Critical of present undergraduate curricula.)

Instruments

NEW DEVELOPMENTS IN THE FIELD OF INSTRUMENT DESIGN AT ZEISS-AEROTOPOGRAPH FROM 1949 TO 1954. Walter A. Brucklacher. *The Australian Surveyor,* Vol. 15, No. 5, March 1955. (Reviews the range of photogrammetric instruments produced since the company resumed operations.)

AN INSTRUMENTATION REFERENCE CENTER. Ens. R. E. Gomory. *Research Reviews* (Office of Naval Research), July 1955. (Describes a project sponsored jointly by the Air Force, Navy, and Atomic Energy Commission to set up an Office of Basic Instrumentation to collect and disseminate general instrument knowledge.)

EVOLUTION OF THE SOLAR TRANSIT. Donald B. Clement. *Our Public Lands,* Vol. 5, No. 3, July–August–September 1955. (Traces development of the instrument, origins of which are attributed to Surveyor William A. Burt in 1836.)

BOOKS AND PAMPHLETS

AMERICAN EPHEMERIS AND NAUTICAL ALMANAC FOR THE YEAR 1957. U. S. Nautical Almanac Office. Washington, *GPO,* 1955. 586 pp.

PROGRESS REPORT ON THE CARTOGRAPHIC ACTIVITIES OF THE UNITED STATES FOR THE PERIOD FROM JULY 1, 1952 TO JUNE 30, 1954. Document for presentation to the VII Pan American Consultation on Cartography, Mexico City, Mexico, July 25, 1955 to August 6, 1955. Submitted by the United States Member of the Commission on Cartography. 1955. 47 pp., maps.

REPORT OF THE LANDS SERVICE YEAR ENDED DECEMBER 31st 1954. Province of British Columbia, Department of Lands and Forests, Victoria, B. C., 1955. 160 pp., maps, illus. (Contains the Report of the Surveys and Mapping Branch with indexes and diagrams.)

FEDERATION OF MALAYA, ANNUAL REPORT OF THE SURVEY DEPARTMENT FOR THE YEAR 1954. C. Noble, Surveyor-General, Malaya. *Government Press,* Kuala Lumpur, 1955. 84 pp., maps.

ADVANCED MATHEMATICS FOR ENGINEERS. H. W. Reddick and F. H. Miller.

Wiley, New York–London, ed. 3, 1955. xiv and 548 pp. Illus. $6.50.

WORLD MAPPING. Prepared by Captain H. Arnold Karo. U. S. Department of Defense, Industrial College of the Armed Forces, Washington, D. C., 1955. 101 pp., processed.

STANDARD SPECIFICATIONS FOR OPERATIONAL PHASE OF AERIAL ELECTRONIC GEODETIC SURVEYING (HIRAN TRILATERATION). U. S. Air Force, Air Photographic and Charting Service, Orlando Air Force Base, 1955. 28 pp.

DISTINCTIVE RECENT MAPS

Interest in surface and sub-surface resources gives to geologic maps a special importance, and publication of a new one is always welcomed. Several have recently been released by the U. S. Geological Survey.

The Geologic Map of New Hampshire, 1955, was prepared in cooperation with the New Hampshire Planning and Development Commission and the Division of Geological Sciences, Harvard University. It was compiled by Marland P. Billings of the latter institution. Based on recent detailed mapping from many sources, this is the first large scale (1:250,000) map of the state to be published since C. H. Hitchcock's compilation of 1877. Distribution of 55 rock units ranging in age from Precambrian to probable Mississippian is shown. The map is supplemented by six east-west cross sections which show structural relations of the rocks. The map, which measures 41 by 54 inches, may be ordered, at $2.00 per copy, from the U. S. Geological Survey, Washington 25, D. C., or the New Hampshire Planning and Development Commission, Concord.

The Montana State Bureau of Mines cooperated with the Geological Survey in the compilation of a new *Geologic Map of Montana*. This map shows the areal distribution of some 75 rock units, ranging from Precambrian schist and gneiss to recent alluvial sand and gravel deposits. The map, which is at the scale of 1:500,000, was compiled by Clyde P. Ross, David A. Andrews, and Irving J. Witkind. It is based upon unpublished data and field work by the Montana School of Mines, and the Universities of Montana, Michigan, Princeton and Harvard. The map is printed on two sheets each measuring 50 by 52 inches. Copies are $3.50 each from the U. S. Geological Survey, Federal Center, Denver, Colo., or Washington 25, D. C. Both the Montana and New Hampshire maps have inset maps showing source of geologic data used.

The U. S. Geological Survey *Geologic Map of Canal Zone and Adjoining Parts of Panama* was compiled by W. P. Woodring and published in 1955 at the scale of 1:75,000. Copies are available at $1.00 each from the Washington and Denver offices of the U. S. Geological Survey. The map covers an area of about 1600 square miles, most of which is in the central Panama Tertiary marine basin. Data used in compiling the map were gathered by the Geological Section of the Panama Canal, Special Engineering Division. The map, which measures approximately 32 by 46 inches, carries both an English and Spanish title.

The Uranium Deposits of the United States are shown on a new map prepared by the U. S. Geological Survey, in cooperation with the Atomic Energy Commission. Principal deposits in this country are located in sandstone of the Colorado Plateau in Arizona, New Mexico, Colorado, and Utah, and in limestone in New Mexico. There are also important deposits in South Dakota and Wyoming marginal to the Black Hills, as well as in other parts of Wyoming. The map measures 34 by 52 inches and is at the scale of 1:5,000,000. Copies of the map are available, at fifty cents, from U. S. Geological Survey Distribution Centers in Washington, D. C., and Federal Center, Denver, Colorado.

An attractive shaded-relief *Map of Oil, Gas & Uranium Resources of Colorado* was prepared for the 1954 Colorado Yearbook through the joint cooperation of Colorado State Oil & Gas Conservation Commission, Jeppeson & Company, and Petroleum Information. The scale is approximately 1:650,000 and the size 16 by 21 inches.

Aero Service Corporation, of Philadelphia, has recently published plastic relief maps for the states of California and Pennsylvania. The *Aero Relief Map of California* measures 41 by 47 inches and is at the scale of 1:1,000,000. It is printed in eight colors on heavy Vinylite plastic, and embossed in three-dimensional relief. The map also shows major types of land use, roads, railroads, other cultural features, and over 3000 geographic names. The price of the California map is $45.00 f.o.b., Philadelphia.

The plastic relief map of *New Jersey* measures 47 by 39 inches and is at the scale of 1:250,000. In addition to three-dimensional relief, the map shows transportation lines, towns and cities classified by population, airports, national and state parks, and various other cultural features. Portions of the adjoining states of Pennsylvania and New York are included on the northern half of the map.

Paul-Emile Victor, polar explorer, is the author of three maps showing the *Ice-Geography of Greenland*. They are drawn on the 1:5,000,000 base map prepared by the Geodaetisk Institut, Köbenhavn, Denmark. The maps show respectively (a) probable extent of summer thaw, (b)

probable limit of the ice-cap, and (c) probable extent of danger zone (crevasses).

Four new maps of the Republic of El Salvador have recently been received. *Mapa Preliminar Básico de El Salvador Con Limites Municipales,* shows boundaries of major and minor political divisions and administrative centers. It was prepared in the Cartography Section of the Direccion General de Estadistica y Censos. The scale is approximately 1:1,000,000 and the size 12 by 19 inches.

Asociacion Cafetalera de El Salvador published in 1954 a map of *El Salvador* showing coffee areas, the Pan American Highway, other major roads, railroads, and ports. The map, which is uncolored, measures 15½ by 23½ inches and is at the scale of 1:500,000.

Mapa General de El Salvador, at the approximate scale of 1:475,000, shows generalized topography as well as roads, railroads, administrative boundaries, and towns and cities graded according to population. It was published by Direccion General de Estadistica y Censos. The map measures approximately 18 by 25 inches.

Junta Nacional de Turismo has issued a tourist and road map of *El Salvador Mostrando Las Carreteras Transitables en Automores.* Distances in kilometers are indicated between towns and junctions. Elevations, in feet, are shown by contours. The map scale is 1:350,000 and the measurements are 20 by 33 inches.

The Departamento de Carreteras published in 1954 three maps of the Republic of Nicaragua, all at the scale of 1:1,000,000, and measuring 24 by 20 inches.

Mapa Fisico de Nicaragua shows generalized relief, by hypsometric tints, as well as roads, railroads, cities and villages. Topography is based on aeronautical charts published by U. S. Aeronautical Chart Service.

Nicaragua Uso Economico de la Tierra is a generalized land-use map which shows cultivated areas as well as forests and swamps.

Three classes of roads, internal and international boundaries, and population distribution are shown on *Nicaragua Mapa Parcial de Caminos.*

A clear, attractive *Railway Map of Danmark Norge Sverige Suomi,* was published in 1953 by Nordisk Turisttrafikkommittee and printed in Sweden by Kartografiska Institutet. Roads, train-ferries, and steamer routes are also shown on the map, which is at the scale of 1:3,000,000. The dimensions are 26 by 20 inches.

Generalstabens Litografiska Anstalt, Stockholm, has recently issued the first four sheets of the new *Topografiska Kartan Över Sverige* (Topographic Map of Sweden) at the scale of 1:50,000. They are the sheets for Stockholm, NE, NW, SE, and SW. According to announced plans, another 15 sheets will be published by the end of 1956, after which 15 to 20 sheets will be issued annually. The maps show relief by contours and are overprinted in green to portray forest. A variety of cultural features are also presented. Map sheets measure approximately 24 by 24 inches.

Fürstentum Liechtenstein is a detailed (1:25,000) topographic presentation of the Duchy, which was published in 1952 by Schulbücherverlag in Vaduz. Topography is depicted by a pleasing blending of contours and color shading, suggestive of Swiss cartography. Towns and cities, roads, railroads, and other cultural features are also shown on the map, which measures 41 by 22 inches.

Cartes des Terres Productives de la Suisse is the title of a new land-use map of Switzerland. Printed on four sheets, each measuring 25 by 37 inches, the map was prepared in the Swiss Division of Agriculture, Berne, and printed by the Topographic Service. It shows cultivated lands, pastures, prairies, forests, and unproductive lands. The scale is 1:200,000.

W. J. Vogt of Pretoria, Transvaal, Union of South Africa, published in 1955 *Union of South Africa Map A, Illustrating the Location of Power Stations Distribution Stations and the Principal Inter Connection Lines.* The map, which is uncolored, also shows steam and electric railways, rivers, and international and provincial boundaries. The scale is 1:2,000,000 and the size 32 by 41 inches.

Forest Resources Map of Malaya is a 1954 publication of the Survey Department, Federation of Malaya. It is at the scale of 1:760,320 and measures 35 by 26½ inches. The map shows game reserves, mining land, several classes of cultivated land, regions over 1000 feet in elevation, as well as several categories of forest reservations and proposed forest reserves.

—WALTER W. RISTOW
Library of Congress

1956 ACSM-ASP CONSECUTIVE MEETINGS AND CO-EXHIBIT
March 19–24, 1956, Washington, D. C.

Books in Review

MODERN SURVEYING FOR CIVIL ENGINEERS. Harold Frank Birchal, late Chief Construction Engineer to the Kenya and Uganda Railways, *Chapman and Hall*, London, 1955.

"Modern Surveying" gets off to a bad start with this reviewer. On the first page it is stated that the civil engineer seldom must "* * * deal with the higher branches such as geodetic surveying, astronomy, etc., and consequently any study of these would be wasted, and as little use to him as a study of theology." One of the major errors of this generation of civil engineers is the adoption of the attitude that the surveying incidental to construction is a sub-professional adjunct to engineering and that, on the other hand, "The higher branches such as geodetic surveying, astronomy, etc." are to be relegated to the ivory-towered abodes of a group of non-practical, long-haired theorists entirely divorced from engineering. To take further issue, we may venture to suggest that a little study of theology would be of immense benefit to the engineer who is so generally engrossed with the materialistic that he is unable to lift his thoughts to the higher planes where engineering projects should be engendered.

After this questionable introduction, the book improves as it proceeds with its avowed purpose of providing data on surveying methods, techniques, and instruments as required by the average civil engineer in the course of preliminary studies and construction design and layout. Particular stress is laid on the importance of the use of a degree of accuracy consistent with the requirements of the construction operation, avoiding both the excessive and the inadequate. It proceeds more or less along the lines of a handbook, describing techniques and listing mathematical formulae but not entering into discussion or derivations.

Typical chapter headings are: chaining, leveling, angular measurements, tacheometry, cross-sectioning, contouring, drainage and stream gauging, etc., plus several chapters on various types of construction layout. Each chapter contains a concise listing and description of the various methods available and suitable for surveys for its particular purpose, and there are many worked-out examples of special-purpose surveys together with feasibility reports and cost estimates. These latter, of course, are based on British Empire practices and unit costs and will not necessarily be valid in U. S. practice except as examples of methods of approach. On the other hand, there are a surprising number of references to and detailed descriptions of the surveys for major construction projects in the United States, e.g. Carquinez Bridge, Calif.; Swift River Reservoir, Boston, Mass.; Cascade Tunnel, Wash.; Florida East Coast Railway viaduct, Long Key, Fla.; and Hoover Dam.

The author has gone to considerable pains to obtain data on the latest designs of instruments and the descriptions, details, comments, and recommendations in this field are particularly valuable.

If the practicing civil engineer (construction) will eschew the derogatory implications concerning geodesy, etc. on the first page, he will find this work a very useful compendium that includes in one book a very complete statement, free of theory and mathematical derivations of surveying techniques available and recommended for nearly every situation that may arise. If, however, the reader would desire to delve into the details and theory of a particular process or instrument, he will wish that the author had been freer with the references to the basic literature and texts to which he obviously had extensive recourse.

RALPH MOORE BERRY

University of Michigan

Low-Expansion Cobalt-Iron-Chromium Alloys

THE NATIONAL BUREAU of Standards announced in August 1955 that experimental work by two members of the Bureau staff had confirmed the findings of some Japanese research work on cobalt-iron-chromium alloys. This may eventually be of considerable interest to surveyors because the work at the National Bureau of Standards indicates the existence of an alloy of these three metals which has a coefficient of expansion of less than 0.000001 per degree C. in the temperature range from 20° to 60° C.

It is in this range (68° F. and upward) that much of the surveyor's field work is done, and it is also true that it is in this temperature range where it is most difficult to assure that the recorded thermometer readings are close to the actual temperature of the tape.

Further work is needed to determine the practicability of this alloy for use in the manufacture of survey tapes. However, the alloy seems to show promise along this line, and further results will be of great interest.

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession.

—EDITOR

U. S. Geological Survey Topographic Maps

THE FOLLOWING quadrangle maps were published by the U. S. Geological Survey between June 1 and August 31, 1955. The list includes newly compiled maps; revised maps on which contours and drainage usually are unchanged but the works of man are brought up to date; and series-converted maps which are 15-minute maps produced from four 7½-minute maps of the same area. The maps are new unless otherwise designated by numerical superscript.

The quadrangle name (in capital letters) is followed by the name of the county (in upper- and lower-case letters) that contains the place or feature for which the quadrangle is named.

All maps are available with or without the green overprint that indicates woodland. These maps show the shape and elevation of the land surface (represented by contour lines, printed in brown); water features (in blue); works of man, including cities, towns, and scattered habitations, schools, churches, railroads, roads and boundaries, place and feature names (in black); and woodland areas (in green). Principal roads are shown by a red overprint. In areas that have been covered by Bureau of Land Management Surveys, township and section lines are shown. The State rectangular coordinate systems are indicated in the margins of the maps. An information folder further describing topographic maps is available on request.

Standard quadrangle maps may be obtained for 20 cents per copy. A discount of 20 percent is allowed on orders amounting to $10 or more at the retail price. Orders should be addressed to the U. S. Geological Survey, Washington 25, D. C., (or Denver 15, Colo., for maps of areas west of the Mississippi River).

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* Indicates 15-minute quadrangle; all others are 7½-minute quadrangles.
[1] Indicates a revised map.
[2] Indicates a series-converted map.
† Indicates availability in either a contour or a shaded-relief edition.
‡ Indicates preliminary black and white edition.

Alabama

MOBILE[1]—Mobile

Alaska

AFOGNAK (A-1)*—Third Judicial Division
AFOGNAK (A-4)*—Third Judicial Division
CIRCLE (A-5)*—Fourth Judicial Division
CIRCLE (B-5)*—Fourth Judicial Division
CIRCLE (B-6)*—Fourth Judicial Division
KAGUYAK (C-6)*—Third Judicial Division
KAGUYAK (D-5)*—Third Judicial Division
KAGUYAK (D-6)*—Third Judicial Division
KARLUK (A-1)*—Third Judicial Division
KARLUK (A-2)*—Third Judicial Division
KARLUK (B-1)*—Third Judicial Division
KARLUK (B-3)*—Third Judicial Division
KARLUK (C-2)*—Third Judicial Division
LIVENGOOD (B-3)*—Fourth Judicial Division
NUSHAGAK BAY (D-3)*—Third Judicial Division
TRINITY ISLANDS (B-2 and C-2)*—Third Judicial Division
TRINITY ISLANDS (B-3 and C-3)*—Third Judicial Division
TRINITY ISLANDS (D-2)*—Third Judicial Division

Arizona

‡EMMETT WASH NE—Coconino
‡EMMETT WASH NW—Coconino
FAIRBANK—Cochise
HEREFORD—Cochise
HEREFORD SW—Cochise
†LEES FERRY NE—Coconino
‡LEES FERRY NW—Coconino
‡LEES FERRY SE—Coconino
‡LEES FERRY SW—Coconino
LEWIS SPRINGS—Cochise
NICKSVILLE—Cochise
‡PARIA PLATEAU NW—Coconino
‡PARIA PLATEAU SE—Coconino
‡PARIA PLATEAU SW—Coconino
STARK—Cochise

‡SHINUMO ALTAR NE—Coconino
‡SHINUMO ALTAR SE—Coconino
‡TANNER WASH NE—Coconino
TOMBSTONE—Cochise
TOMBSTONE SE—Cochise

California

AGUANGA—Riverside
ALLENSWORTH—Tulare
BOLINAS—Marin
BRUCEVILLE[1]—Sacramento
CALAVERAS RESERVOIR—Santa Clara
CORTINA CREEK[1]—Colusa
CUPERTINO—Santa Clara
DELANO WEST—Kern
DEVILS POSTPILE*—Madera
EDISON—Kern
FOLSOM SE—Sacramento
GLAMIS SW—Imperial
GLENDORA[1]—Los Angeles
GLEN ELLEN—Sonoma
GRIMES—Colusa
HEMET—Riverside
HUNTINGTON LAKE*—Fresno
INVERNESS—Marin
MERCED PEAK*—Madera
MIDWAY WELL—Imperial
MIDWAY WELL NW—Imperial
MILPITAS—Santa Clara
MT. ABBOT*—Fresno
MURRIETA—Riverside
PALO ALTO—Santa Clara
PATTERSON—Stanislaus
PENNINGTON—Sutter
PETALUMA—Sonoma
POINT REYES NE—Marin
RIO VISTA—Solano
SAN GERONIMO—Marin
SAN JOSE EAST—Santa Clara
SAN JOSE WEST—Santa Clara
SITTON PEAK—Riverside
SNELLING—Merced
TRACY—San Joaquin
TWO ROCK—Sonoma
VALLEY FORD—Sonoma
VAN NUYS—Los Angeles

California-Arizona

GRAYS WELL NE—Imperial

Colorado

DIVIDE—Teller
PALMER LAKE—El Paso
SIGNAL BUTTE—Teller
WOODLAND PARK—Teller

Connecticut

NORWICH[1]—New London

Delaware

MILFORD—Sussex
TRAP POND—Sussex

Florida

FELLSMERE 4 NE—Indian River
FORT PIERCE SW—St. Lucie
INDIAN TOWN—Martin
KISSIMMEE—Osceola
OKEECHOBEE 1 NW—St. Lucie
OKEECHOBEE 1 SE—St. Lucie
PINE CASTLE—Orange

Georgia

METASVILLE—Wilkes

Idaho

BOILING SPRINGS*—Valley
STAR—Ada

Illinois

JOLIET—Will
SAG BRIDGE[1]—Cook
SAILOR SPRINGS*—Clay
TEUTOPOLIS*—Effingham
WEST CHICAGO—DuPage

Indiana

GARY—Lake
LEBANON—Boone
WESTVILLE—La Porte
WHITING—Lake

Indiana-Kentucky

AURORA—Dearborn

Kansas

ALMA—Wabaunsee
McFARLAND—Wabaunsee

Kentucky

ADAMS—Lawrence
BLAINE—Lawrence
BOBTOWN—Pulaski
CANE VALLEY—Adair
CANMER—Hart
COOPERSVILLE—Wayne
DELAPLAIN—Scott
DICKEYS MILLS—Grayson
EXIE—Green
FRAZER—Wayne
FRANKFORT EAST—Franklin
GAMALIEL—Monroe
GLEN DEAN—Breckinridge
IVYTON—Magoffin
KNIPLEY—Adair
LEBANON WEST—Marion
LOAD—Greenup
MACEO—Daviess
MONTPELIER—Adair
MUNFORDVILLE—Hart
NEVELSVILLE—McCreary
NEW CASTLE—Henry
OFFUTT—Johnson
OIL SPRINGS—Johnson
OLATON—Ohio
PAINTSVILLE—Johnson
SWITZER—Franklin
THOMAS—Floyd

Kentucky-Indiana

LEWISPORT—Hancock

Kentucky-Tennessee

FROGUE—Cumberland

Kentucky-West Virginia-Virginia

MAJESTIC—Pike

Louisiana

CLINTON—East Feliciana
ELM PARK—East Feliciana
GONZALES—Ascension
GROSSE TETE—Iberville
JACKSON—East Feliciana
PORT HUDSON — East Baton Rouge
PRIDE—East Baton Rouge
SCOTLANDVILLE — East Baton Rouge
WALLS—West Baton Rouge
WATSON—Livingston
ZACHARY—East Baton Rouge

Louisiana-Mississippi

ARTONISH*—Wilkinson

Maine

ALLAGASH LAKE*—Piscataquis
BAKER LAKE*—Somerset
CAUCOMGOMOC LAKE*—Piscataquis
CHESUNCOOK*—Piscataquis
CHURCHILL LAKE* — Piscataquis
GRANT FARM*—Piscataquis
NEW SWEDEN—Aroostook
NORTH EAST CARRY*—Piscataquis
PORTAGE[2]—Aroostook
PRESQUE ISLE[2]—Aroostook
ST. JOHN POND*—Somerset
SEBOOMOOK LAKE*—Somerset
SPIDER LAKE*—Piscataquis
SQUARE LAKE*[2]—Aroostook

Maryland

REISTERTOWN[1]—Baltimore
ROCK HALL[1]—Kent
UNION BRIDGE[1]—Carroll

Massachusetts

WARREN[1]—Worcester

Massachusetts-New Hampshire

WINCHENDON[1]—Worcester

Michigan

AUGUSTA—Kalamazoo
BANFIELD—Calhoun
BATTLE CREEK—Barry
BEDFORD—Calhoun
BELLEVUE—Eaton
BIG BEAVER—Chipppewa
CERESCO—Calhoun
DELTON—Barry
DENTON—Wayne
EMERSON—Chippewa
GALESBURG—Kalamazoo
PIATT LAKE—Chippewa
SALEM—Washtenaw
SHEEPHEAD LAKE—Chippewa
SHELLDRAKE—Chippewa
TIMBERLOST—Chippewa
VERMILION—Chippewa
VERMILION SE—Chippewa
WHITEFISH POINT—Chippewa
YPSILANTI EAST—Washtenaw

Minnesota

ATKINSON—Carlton
BARRS LAKE—St. Louis
CLOQUET—Carlton
McCARTHY CREEK—St. Louis
THOMPSON LAKE—St. Louis
WHYTE*—Lake
WRENSHALL—Carlton

Minnesota-South Dakota

BELLINGHAM*—Lac Qui Parle

Minnesota-Wisconsin

ESKO—Carlton
FOXBORO—Douglas
FROGNER—Carlton

Mississippi

COFFEEVILLE*—Yalobusha
WATER VALLEY*—Yalobusha

Missouri

ARMSTRONG—Howard
BEAMAN—Pettis
BEVIER SOUTH—Macon
CALHOUN EAST—Henry
CALHOUN WEST—Henry
CLIFTON CITY—Cooper
CLINTON SOUTH—Henry
COLLEGE MOUND—Macon
CREIGHTON—Cass
GAINES—Henry
HUNTSVILLE—Randolph
JOHNSTOWN—Bates
LAGONDA—Chariton
LEESVILLE—Henry
MOBERLY—Randolph
MONTROSE—Henry
MIDDLE GROVE—Monroe
PRAIRIE HILL—Chariton
WIEN—Chariton

Montana

PN RANCH—Fergus

Nebraska

ASHTON—Sherman
COTESFIELD—Howard
LOUP CITY—Sherman
LOUP CITY NW—Sherman
LOUP CITY SE—Sherman
NORTH LOUP—Valley
RAVENNA—Buffalo
RAVENNA NW—Sherman

Nevada

BARE MTN.*—Nye

Nevada-California

BULLFROG*—Nye

New Jersey

BRANCHVILLE[1]—Sussex
NEWFOUNDLAND[1]—Passaic
NEWTON EAST[1]—Sussex
NEWTON WEST[1]—Sussex

New Mexico

ALAMEDA—Bernalillo
BERNALILLO—Sandoval
BOSQUE PEAK—Torrance
CAPILLA PEAK—Torrance

CHIMAYO—Rio Arriba
HAGAN—Sandoval
LA MESITA NEGRA—Bernalillo
LOMA MACHETE—Sandoval
LOS GRIEGOS—Bernalillo
SANDIA CREST—Bernalillo
SANDIA PARK—Bernalillo
SAN FELIPE PUEBLO—Sandoval
SAN FELIPE PUEBLO NE—Sandoval
SEDILLO—Bernalillo
TAJIQUE—Torrance
TIJERAS—Bernalillo
TORREON—Torrance
VELARDE—Rio Arriba

New York

BATH—Steuben
DELMAR—Albany
GENEVA NORTH—Ontario
HAMMONDSPORT—Steuben
HILLSDALE—Columbia
HUDSON NORTH—Columbia
KENNEDY—Chautauqua
KINDERHOOK—Columbia
RATHBONE—Steuben
RAVENA—Albany
TOWLESVILLE—Steuben
WEST NINEMILE PT.—Cayuga

New York-Massachusetts

COPAKE—Columbia

New York-Pennsylvania

SEELEY CREEK—Chemung

North Carolina

ROANOKE ISLAND NE—Dare
WANCHESE—Dare

North Dakota

ADRIAN—La Moure
JUD—La Moure
JUD SE—La Moure
MILLARTON—Stutsman
MONTPELIER—Stutsman
MONTPELIER NW—Stutsman
NORTONVILLE—La Moure

North Dakota-South Dakota

ELLENDALE SOUTH—Dickey
KIDDER—Marshall
NEWARK—Marshall

Ohio

AVON—Lorain
BEREA—Cuyahoga
BROADVIEW HEIGHTS—Cuyahoga
CINCINNATI EAST—Hamilton
CINCINNATI WEST—Hamilton
CLEVELAND SOUTH—Cuyahoga
EAST CLEVELAND—Cuyahoga
MAYFIELD HEIGHTS—Cuyahoga
SHAKER HEIGHTS—Cuyahoga
TWINSBURG—Summit

Ohio-Kentucky

ADDYSTON—Hamilton

Oregon

KIMBERLY*—Grant
PICTURE GORGE*—Grant

Oregon-Washington

RANIER—Columbia

Pennsylvania

ALIQUIPPA—Beaver
AMBRIDGE—Beaver
AVELLA—Washington
BEAVER—Beaver
BRIDGEVILLE—Allegheny
BURGETTSTOWN—Washington
CALIFORNA—Washington
ELLSWORTH—Washington
FREEPORT—Armstrong
GLASSPORT—Allegheny
GREENSBURG—Westmoreland
HOOKSTOWN—Beaver
McKEESPORT—Beaver
MIDWAY—Washington
MIFFLINBURG*‡—Snyder
MURRYSVILLE—Westmoreland
NEW KENSINGTON EAST—Westmoreland
SMITHTON—Westmoreland
WASHINGTON EAST—Washington
WASHINGTON WEST—Washington

Pennsylvania-Delaware

WEST GROVE—Delaware

South Dakota

ASHTON—Spink
BRENTFORD—Spink
BRITTON EAST—Marshall
CUSTER—Custer
DEADMAN MTN.—Meade
FRANKFORT—Spink
FREDERICK—Brown
GALLUP—Spink
GROTON SW—Brown
HAYWARD—Pennington
HOUGHTON—Brown
HILL CITY—Pennington
IRON MOUNTAIN—Pennington
MOUNT RUSHMORE—Pennington
NEWARK SW—Marshall
PACTOLA DAM—Pennington
PIERRE 3 NW—Hughes
ROCKERVILLE—Pennington
STRATFORD—Brown
WARNER—Brown

Tennessee

AUSMUS[1]—Claiborne
BACON GAP[1]—Roane
BEARDEN[1]—Knox
BETHEL VALLEY[1]—Roane
BIG RIDGE PARK[1]—Union
BLOCKHOUSE[1]—Blount
BOYDS CREEK[1]—Sevier
CAMP AUSTIN[1]—Morgan
CARDIFF[1]—Roane
CAVE CREEK[1]—Roane
CLINTON[1]—Anderson
CONCORD[1]—Knox
ELVERTON[1]—Roane
FOUNTAIN CITY[1]—Knox
HARRIMAN[1]—Roane
JOHN SEVIER[1]—Knox
KINZEL SPRINGS[1]—Blount
KNOXVILLE[1]—Knox
LAKE CITY[1]—Anderson
LANCING[1]—Morgan
LENOIR CITY[1]—Loudon
LONEWOOD—Van Buren
LOUISVILLE[1]—Blount
LOVELL[1]—Knox
MARYVILLE[1]—Blount
MASCOT[1]—Knox
McMINNVILLE—Warren
NORRIS[1]—Anderson
PETROS[1]—Morgan
POWDER SPRINGS[1]—Grainger
POWELL[1]—Knox
ROCKWOOD[1]—Roane
SAMPSON—Bledsoe
SHOOKS GAP[1]—Knox
SPARTA—White
SPENCER—Van Buren
STOCKTON—Fentress
WALDEN CREEK[1]—Sevier
WEAR COVE[1]—Sevier
WELL SPRING[1]—Campbell
WHITE HOLLOW[1]—Union
WHITE HOUSE—Sumner
WILDWOOD[1]—Blount
WINDROCK[1]—Anderson

Texas

GUADELUPE PEAK*†—Culberson
PHILLIPS—Hutchinson

Utah

‡BEAVER NE—Beaver
‡BEAVER SE—Beaver
‡BUCKSKIN GULCH NE—Kane
‡BUCKSKIN GULCH NW—Kane
‡CLAY HILLS 1 NE—San Juan
‡CLAY HILLS 1 NW—San Juan
‡CLAY HILLS 2 NE—San Juan
‡CLAY HILLS 2 NW—San Juan
‡ELK RIDGE 1 NE—San Juan
‡ELK RIDGE 1 NW—San Juan
‡ELK RIDGE 1 SE—San Juan
‡ELK RIDGE 1 SW—San Juan
‡ELK RIDGE 2 NE—San Juan
‡ELK RIDGE 2 NW—San Juan
‡ELK RIDGE 2 SE—San Juan
‡ELK RIDGE 2 SW—San Juan
‡ELK RIDGE 3 NE—San Juan
‡ELK RIDGE 3 SE—San Juan
‡ELK RIDGE 4 NW—San Juan
‡ELK RIDGE 4 SW—San Juan
‡NAVAJO MTN. 4 NE—San Juan
‡TIDWELL—1 NE—Grand
‡TIDWELL 1 SE—Emery
‡TIDWELL 2 NE—Emery
‡TIDWELL 2 SE—Emery
‡VERDURE 1 SE—San Juan
‡VERDURE 2 SE—San Juan
‡VERDURE 3 NE—San Juan
‡VERDURE 3 SE—San Juan
‡VERDURE 4 NW—San Juan
‡VERDURE 4 SW—San Juan

Utah-Arizona

‡BUCKSKIN GULCH SE—Kane
‡BUCKSKIN GULCH SW—Kane
‡NAVAJO MTN. 4 SE—San Juan

Virginia-Kentucky

HURLEY—Buchanan

Washington

ADNA*—Lewis
BEVERLY NE—Grant
BREMERTON EAST—Kitsap
EVERETT—Snohomish
MT. BRYNION—Cowlitz
MT. CHALLENGER*—Whatcom
MT. TEBO—Mason
SPOKANE*‡—Spokane
WELLPINIT*[1]—Stevens

Washington-Oregon

KALAMA—Cowlitz
KELSO—Cowlitz

West Virginia-Kentucky

WEBB—Wayne

West Virginia-Virginia-Kentucky

WHARNCLIFFE—Mingo

Wisconsin

AMICON LAKE—Douglas
BOREA—Douglas
CLOVERLAND—Douglas
LAKE NEBAGAMON—Douglas
LANGLADE*—Langlade
LYMAN LAKE—Douglas
NEILLSVILLE*—Clark
PATZAU—Douglas
POPLAR—Douglas
POPLAR NE—Douglas
SOUTH RANGE—Douglas
SUNNYSIDE—Douglas
WHITE LAKE*—Langlade

Wisconsin-Minnesota

PARKLAND—Douglas
SUPERIOR—Douglas
WEST DULUTH—St. Louis

Wyoming

FOURMILE POINT—Carbon
FOURMILE RIDGE—Carbon
LEO—Carbon

In addition to the standard series of quadrangle maps, small-scale (1:250,000) maps of areas in the United States and Territories are being published and distributed. Some of these maps are published in a shaded-relief edition, as indicated in the list below. They

may be purchased from the Geological Survey for 50 cents per copy. An index to the series is available on request.

Alaska

ILIAMNA†
FAIRBANKS†
MT HAYES†
PORT ALEXANDER†
SITKA†
TANANA

Alabama-Georgia-Florida

DOTHAN

Illinois-Wisconsin

ROCKFORD

North Carolina

WANCHESE

Tennessee-North Carolina-South Carolina

KNOXVILLE

Texas

BROWNWOOD
LLANO
WACO

West Virginia-Virginia-Kentucky

BLUEFIELD

Public Land Survey Plats

THE FOLLOWING plats of public land surveys and resurveys were completed and accepted by the Bureau of Land Management between June 1 and August 31, 1955. The class or purpose of the survey is indicated. Copies of the plats may be secured from the Bureau Offices in the States or from the Director, Bureau of Land Management, Department of the Interior, Washington 25, D. C.

Alaska

Lisianski Homesite Group—U. S. Survey 3305
Eagle River Landing Group—U. S. Survey 3325
Juneau Small Tract Group—U. S. Survey 3379
Herring Bay Small Tract Group—U. S. Survey 3385
Juneau Small Tract Group No. 2.—U. S. Survey 3395

Alaska—Fairbanks Meridian

T. 2 S., R. 2 E.—subdivision of sections

Alaska—Seward Meridian

T. 14 N., R. 1 W.—subdivision of sections
T. 15 N., R. 1 W.—subdivision of sections

Alaska—Copper River Meridian

T. 2 N., R. 1 E.—subdivision of sections
T. 2 N., R. 1 W.—subdivision of sections

Arizona—Gila and Salt River Meridian

T. 5 S., R. 8 E.—subdivision of sections
T. 15 S., R. 10 E.—subdivision of sections
T. 16 S., R. 10 E.—subdivision of sections
T. 15 S., R. 12 E. (2 plats)—subdivision of sections
T. 14 S., R. 13 E.—subdivision of sections
T. 15 S., R. 13 E. (4 plats)—subdivision of sections
T. 24 S., R. 20 E.—subdivision of sections
T. 24 S., R. 21 E.—subdivision of sections

California—San Bernardino Meridian

T. 9 N., R. 2 W.—subdivision of sections

Colorado—Sixth Principal Meridian

T. 19 S., R. 70 W.—dependent resurvey
T. 27 S., R. 73 W.—subdivision of sections

Colorado—New Mexico Principal Meridian

T. 40 N., R. 12 E.—subdivision of sections
T. 41 N., R. 12 E.—subdivision of sections
T. 40 N., R. 13 E.—subdivision of sections

Idaho—Boise Meridian

T. 3 N., R. 3 W.—subdivision of sections
T. 11 S., R. 25 E.—dependent resurvey

Louisiana—Louisiana Meridian

T. 23 S., R. 20 E.—island survey

Michigan—Michigan Meridian

T. 6 S., R. 1 E.—resurvey and subdivision of sections
T. 6 S., R. 8 E.—resurvey and subdivision of sections
T. 6 S., R. 9 E.—resurvey and subdivision of sections

Montana—Principal Meridian

T. 30 N., R. 1 E.—dependent resurvey
T. 30 N., R. 2 E.—dependent resurvey
T. 30 N., R. 3 E.—dependent resurvey
T. 31 N., R. 3 E.—dependent resurvey
T. 30 N., R. 4 E.—dependent resurvey
T. 31 N., R. 4 E.—dependent resurvey
T. 29 N., R. 5 E.—dependent resurvey
T. 30 N., R. 5 E.—dependent resurvey
T. 29 N., R. 6 E.—dependent resurvey
T. 29 N., R. 7 E.—dependent resurvey
T. 30 N., R. 1 W.—dependent resurvey
T. 31 N., R. 1 W.—dependent resurvey
T. 3 S., R. 58 E.—dependent resurvey
T. 4 S., R. 58 E.—dependent resurvey
T. 5 S., R. 58 E.—dependent resurvey
T. 3 S., R. 59 E.—dependent resurvey
T. 4 S., R. 59 E.—dependent resurvey

Nebraska—Sixth Principal Meridian

T. 14 N., R. 10 W.—dependent resurvey
T. 15 N., R. 10 W.—dependent resurvey
T. 13 N., R. 11 W.—dependent resurvey
T. 14 N., R. 11 W.—dependent resurvey
T. 15 N., R. 11 W.—dependent resurvey
T. 13 N., R. 12 W.—dependent resurvey
T. 14 N., R. 12 W.—dependent resurvey
T. 15 N., R. 12 W.—dependent resurvey
T. 16 N., R. 12 W.—dependent resurvey
T. 14 N., R. 13 W.—dependent resurvey
T. 15 N., R. 13 W.—dependent resurvey
T. 16 N., R. 13 W.—dependent resurvey
T. 17 N., R. 13 W.—dependent resurvey
T. 18 N., R. 13 W.—dependent resurvey
T. 15 N., R. 14 W.—dependent resurvey
T. 16 N., R. 14 W.—dependent resurvey
T. 17 N., R. 14 W.—dependent resurvey
T. 18 N., R. 14 W.—dependent resurvey
T. 16 N., R. 15 W.—dependent resurvey
T. 17 N., R. 15 W.—dependent resurvey
T. 18 N., R. 15 W.—dependent resurvey
T. 17 N., R. 16 W.—dependent resurvey
T. 18 N., R. 16 W.—dependent resurvey
T. 17 N., R. 17 W.—dependent resurvey
T. 18 N., R. 17 W.—dependent resurvey
T. 5 N., R. 25 W.—dependent resurvey
T. 5 N., R. 26 W.—dependent resurvey
T. 6 N., R. 26 W.—dependent resurvey
T. 3 N., R. 28 W.—dependent resurvey
T. 2 N., R. 29 W.—dependent resurvey
T. 3 N., R. 29 W—dependent resurvey
T. 2 N., R. 30 W.—dependent resurvey
T. 3 N., R. 30 W.—dependent resurvey
T. 2 N., R. 31 W—dependent resurvey
T. 3 N., R. 31 W.—dependent resurvey
T. 2 N., R. 32 W.—dependent resurvey

Nevada—Mount Diablo Meridian

T. 43 N., R. 23 E.—resurvey[1]
T. 44 N., R. 26 E.—resurvey[1]
T. 45 N., R. 26 E.—resurvey[1]
T. 46 N., R. 26 E.—resurvey[1]
T. 46 N., R. 27 E.—resurvey[1]
T. 46 N., R. 28 E.—resurvey[1]
T. 47 N., R. 28 E.—resurvey[1]
T. 11 S., R. 46 E.—survey[2]
T. 11 S., R. 43 E.—survey[2]
T. 13 S., R. 46 E.—survey[2]
T. 10 S., R. 69 E.—original survey

New Mexico—New Mexico Principal Meridian

T. 13 N., R. 4 E.—resurvey and subdivision of sections
T. 17 N., R. 9 E.—subdivision of sections
T. 23 N., R. 10 E.—resurvey and subdivision of sections
T. 32 N., R. 12 W.—dependent resurvey

[1] Resurvey, boundaries of Charles Sheldon Antelope Range.
[2] Survey, boundary of Death Valley National Monument.

South Dakota—Fifth Principal Meridian

T. 113 N., R. 65 W.—dependent resurvey
T. 112 N., R. 66 W.—dependent resurvey
T. 113 N., R. 66 W.—dependent resurvey
T. 114 N., R. 66 W.—dependent resurvey
T. 113 N., R. 67 W.—dependent resurvey
T. 114 N., R. 67 W.—dependent resurvey
T. 113 N., R. 68 W.—dependent resurvey
T. 112 N., R. 69 W.—dependent resurvey
T. 113 N., R. 69 W.—dependent resurvey

South Dakota—Black Hills Meridian

T. 1 N., R. 5 E.—dependent resurvey
T. 2 N., R. 5 E.—dependent resurvey

Utah—Salt Lake Meridian

T. 36 S., R. 5 E.—skeleton survey
T. 37 S., R. 5 E.—skeleton survey
T. 36 S., R. 6 E.—skeleton survey
T. 37 S., R. 6 E.—skeleton survey
T. 26 S., R. 10 E.—skeleton survey
T. 27 S., R. 10 E.—skeleton survey
T. 26 S., R. 16 E.—skeleton survey
T. 25 S., R. 17½ E.—skeleton survey
T. 26 S., R. 17½ E.—skeleton survey
T. 27 S., R. 17½ E.—skeleton survey
T. 28 S., R. 17½ E.—skeleton survey
T. 25 S., R. 18 E.—skeleton survey
T. 26 S., R. 18 E.—skeleton survey
T. 27 S., R. 18 E.—skeleton survey
T. 28 S., R. 18 E.—skeleton survey
T. 25 S., R. 19 E.—skeleton survey
T. 26 S., R. 19 E.—skeleton survey
T. 27 S., R. 19 E.—skeleton survey
T. 28 S., R. 19 E.—skeleton survey
T. 5 S., R. 23 E.—dependent resurvey

Washington—Willamette Meridian

T. 32 N., R. 41 E.—dependent resurvey
T. 33 N., R. 41 E.—dependent resurvey
T. 31 N., R. 42 E.—dependent resurvey

Wisconsin—Fourth Principal Meridian

T 37 N., R. 10 E.—omitted land survey

Wyoming—Wind River Meridian

T. 1 S., R. 1 W.—subdivision of sections

Wyoming—Sixth Principal Meridian

T. 13 N., R. 82 W.—extension survey

Lake Survey Charts

PUBLICATION of new editions of the following Lake Survey Charts has been announced by the United States Lake Survey of the Corps of Engineers, U. S. Army. Copies of these charts may be obtained from the U. S. Lake Survey, 630 Federal Bldg., Detroit 26, Mich., at 75 cents per copy. Payment is required in advance by P. O. money order or draft, payable to the Treasurer of the United States.

3.—Lake Erie. General chart of entire lake, at 1:400,000 scale. (July 1955)
39.—Coast Chart. West end of Lake Erie, from Pelee Point, Ont., and Sandusky, Ohio, to mouth of Detroit River, at 1:100,000 scale. (August 1955)
41.—Detroit River. Three miles south of Detroit River Light to Windmill Point, Mich., at 1:30,000 scale. August 1955)
52.—Coast Chart. Pte. aux Barques, Mich., to 11 miles north of Oscoda, Mich., including Saginaw Bay, at 1:120,000 scale, with insets of Tawas Harbor, Mich., at 1:30,000 scale, and entrance to Au Sable River, Mich., at 1:10,000 scale. (February 1955)
53.—Coast Chart. Thirteen miles south of Sturgeon Point, Mich., to Forty Mile Point Light, Mich., including Great Duck Island, at 1:120,000 scale, with insets of Alpena, Mich., at 1:15,000 scale, and Rogers City and Calcite, Mich., at 1:20,000 scale. (February 1955)
60.—Coast Chart. Detour passage to Waugoshance Point, Mich., at 1:80,000 scale, with insets of Cheboygan, Mich., at 1:15,000 scale, Mackinac Island, Mich., at 1:10,000 scale, Mackinaw City, Mich., at 1:15,000 scale, and St. Ignace, Mich., at 1:15,000 scale. (June 1955)
61.—St. Marys River. Lake Huron to Lake Munuscong, including Potagannissing Bay, at 1:40,000 scale. (June 1955)
63.—St. Marys River. Head of Lake Nicolet to Whitefish Bay at 1:40,000 scale, with inset of Sault Ste. Marie, at 1:20,000. (June 1955)
92.—Coast Chart. St. Marys River to Au Sable Point, Mich., and to Montreal Shoal, Ont., at 1:120,000 scale, with inset of Grand Marais, Mich., at 1:15,000 scale. (July 1955)
93.—Coast Chart. Grand Marais, Mich., to Big Bay Point, Mich., at 1:120,000 scale. (July 1955)
96.—Coast Chart. West of Little Girls Point, Mich., and Beaver Bay, Minn., including Duluth, Minn., and Apostle Islands, at 1:120,000 scale, with insets of Port Wing Harbor, Wis., at 1:10,000 scale, Two Harbors, Minn., at 1:10,000 scale, and Cornucopia, Wis., at 1:5,000 scale. (June 1955)
537.—Presque Isle and Rockport Harbors, Thunder Bay Island to Presque Isle, Mich., at 1:60,000 scale, with insets of Rockport, Mich., at 1:10,000 scale, and Presque Isle Harbor, Mich., at 1:15,000 scale. (June 1955)
723.—Menominee Harbor, Mich., and Marinette Harbor, Wis., at 1:15,000 scale. (June 1955)
935.—Marquette and Presque Isle Harbors, Mich., at 1:15,000 scale. (June 1955)
961.—Apostle Islands, Wis., and coast from Oronto Bay to Sand Island Light, Wis., including Chequamegon Bay, at 1:60,000 scale, with inset of Bayfield, Wis., at 1:10,000 scale. (June 1955)
964.—Ashland and Washburn Harbors, Wis., at 1:15,000 scale. (June 1955)
966.—Duluth-Superior Harbor at 1:15,000 scale. (June 1955)
981.—Isle Royale, Mich., at 1:40,000 scale. (June 1955)

Annual Map Production Tabulated by Countries

A DETAILED STUDY of the world's annual production of maps was recently completed by Arch C. Gerlach, Chief of the Map Division of the Library of Congress.

Dr. Gerlach's tabulation is based upon an average of the maps published in 1951 and 1952 according to three sources of information: (1) Reports of map production to the *Bibliographie Cartographique Internationale* from 22 countries; (2) reports of cartographic progress in the Americas, made at the 1952 meeting of the Commission on Cartography of the Pan American Institute of Geography and History; and (3) maps from these and other countries deposited in the cartographic collections of the Library of Congress.

A limited number of reprints of the study are available upon request to Dr. Gerlach, Map Division, Library of Congress, Washington 25, D. C.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way.
—EDITOR

SCIO—I KNOW

WALTER S. DIX*—One of those transcribed word substitutions in steno-reporting, which are the bane of the lives of all secretaries and editors, completely changes the sense of Past President Merriam's closing remarks at the business session of the 15th Annual Meeting as reported in SURVEYING AND MAPPING for April–June 1955, page 256. He said "scio" but it transcribed as "skill." The reader might wonder how a profession could possibly lean too heavily on "skill," and also how skill could be the root of the word "science," which root of course is "scio," the Latin for "I know." And although "skil" from Icelandic derivation refers to knowledge, it is more closely related to the arts—the application of knowledge rather than the establishment of it.

What was intended by President Merriam was the implication that as engineers we might be too inclined to assume knowledge to be absolute, since science, derived from the Latin "scio," deals essentially in the known, and thus erroneously conclude that to be perfectly equipped for a professional career it is only necessary to be provided with a *mental* toolbox containing an appropriate set of *established facts*.

Readers of SURVEYING AND MAPPING can readily see the nonstatic nature of our branch of applied science and appreciate the need for imagination to expand in response to ever widening horizons.

* Executive Secretary, ACSM.

SQUARE ROOT

SERGE A. EMERY—Many survey computations can be made quickly by using squares of numbers or square roots. Squares of numbers can be obtained from special tables of squares, etc., or by using a computing machine. Square roots can also be obtained from tables, but only to a few significant figures. The use of computing machines for finding a square root directly is not recommended because this computation is a long and complicated procedure. However, a division process can be used easily and the square root determined indirectly. An approximate value can be taken from a table of squares and used as a divisor. The square root is the arithmetic mean of the divisor and quotient. The accuracy is dependent upon the balance of significant figures. The quotient cannot have more than twice the number of digits in the divisor. Thus, if 7 figures are needed in the answer, the divisor should have at least 4 digits and the quotient should be identical for the first 3 and no more than 1 or 2 units different in the 4th figure. Proof of this will be found in standard mathematical texts, but seldom in surveyors' handbooks. Most surveyors have tables of squares or can easily obtain tables with a sufficient number of figures for this quick method of computing square root.

NEW DETERMINATION OF LAKE MICHIGAN AREAS IN ILLINOIS

ROBERT H. ENGLE*—Illinois has adopted an amendment to its Constitution which will require the General Assembly to create 58 "contiguous and compact" districts in the formation of which "area shall be the prime consideration." This will require the General Assembly to know how much of Lake Michigan is in Lake County, Ill., and how much is in Cook County, Ill.

In the absence of any published data to

* 6026 S. Ellis Ave., Chicago, Ill.

answer these questions, I have measured these areas using maps of the United States Geological Survey and the United States Lake Survey.

The legal boundaries of the State of Illinois extend to the middle of Lake Michigan between the northern border of Indiana and parallel 42°30′. All of this area is within Lake and Cook Counties. I have used as the Lake-Cook boundary, a line extending east from a point on the shore of Lake Michigan 24.6 miles south of 42°30′. The northern boundary of Indiana was measured as approximately 51 miles south of 42°30′.

The task was one of measuring one half the east-west width of Lake Michigan, at one mile intervals, from 42°30′ to the northern border of Indiana, on United States Lake Survey map No. 7, of Lake Michigan, scale 1:500,000 (1 inch equals 7.8914 miles.) The arithmetic mean of two successive measurements was taken as the representative length of the contained mile-wide strip, and its area in square miles. The sum of the 24.6 most northern strips is the area of Lake Michigan in Lake County, Ill. The sum of the areas of the remaining mile-wide strips is the area of Lake Michigan in Cook County, Ill. The sum of the areas in Lake and Cook Counties is the area of Lake Michigan in Illinois. My results are as follows:

The Areas of Lake Michigan in Illinois

In Lake County	932 square miles
In Cook County	712 square miles
Total in Illinois	1,644 square miles.

These results are submitted as approximations which I hope will be checked by competent cartographers, particularly since the total of 1,644 is 7.7 percent greater than the 1,526 square miles reported by the United States Bureau of the Census in "Areas of the United States."

Ohio State Confers Doctorate Degree in Geodesy

ON AUGUST 26, 1955, Colonel Clair E. Ewing, U. S. Air Force, received the degree of Doctor of Philosophy in Geodetic Science from the Institute of Geodesy, Photogrammetry, and Cartography of Ohio State University. Colonel Ewing served as Commander of the 1st Shoran Beacon Squadron in Korea and later as the Commander of the 5th Shoran Beacon Unit of the Strategic Air Command. He was recently appointed Director of Range Development for the Air Force Missile Test Center at Patrick Air Force Base.

The Institute of Geodesy, Photogrammetry, and Cartography was organized in 1950 and has made continued progress in the development of an educational program in which graduate studies may be pursued in each of these sciences. Under the direction of Dr. W. A. Heiskanen some of the world's foremost geodesists, photogrammetrists, and cartographers have been brought together at Columbus, Ohio.

Canadian Scholarship in Surveying

THE PRESIDENT'S PAGE of the July 1955 issue of *The Canadian Surveyor* carries a picture showing the presentation of a scholarship by the Royal Canadian Engineers to Lucien Landry, officer cadet and student of the Faculty of Land Surveying and Forest Engineering of Laval University. Mr. Landry received his B.A. degree from l'Assomption College in 1951. He received the degree of Bachelor of Applied Science (Surveying) in June 1955.

President Marcel Ste. Marie, of the Canadian Institute of Surveying and Photogrammetry, in commenting on the event, wrote as follows:

"The presentation of this scholarship is an encouraging sign to those who are concerned about teaching and training students in surveying at the universities . . . a concern to which expression has been given in several issues of *The Canadian Surveyor*. With the accelerated development of our natural resources, accompanied by a refinement of surveying methods and the introduction of new techniques and equipment, there is a great demand for the services of Canadian surveyors and the future of the profession appears very bright. All honor to Laval and to the Corps of Engineers for their encouragement and assistance to a promising survey student."

News of Related Organizations

International Society for Photogrammetry

The International Society for Photogrammetry will hold its VIII International Congress and Exposition of Photogrammetry in Medborgarhuset, Stockholm, Sweden, July 17–26, 1956, with Technical Tours extending from July 26 through August 2.

The exhibition halls are now open for final reservations. An exhibitor's brochure and information concerning the meetings may be obtained by writing to The Photogrammetric Congress Bureau, Stockholm 70, Sweden.

Florida Society of Professional Land Surveyors

The Florida Society of Professional Land Surveyors, formally organized in June 1955, lists the following officers:

President, H. O. Peters, Leesburg
Vice President, Harry C. Schwebke, Miami
Secretary-Treasurer, R. H. Jones, Orlando

The Board of Directors, two from each of the five State Districts:

Northwest Florida
Perry C. McGriff, Gainesville
Fred M. Stevenson, Marianna
Northeast Florida
Russell H. DeGrove, Jacksonville
John J. Matejka, Jr., Daytona Beach
Central Florida
William D. Bruner, Titusville
Roger E. Miller, Sebring
Southwest Florida
James V. Mosby, Sarasota
Hugh A. Binyon, St. Petersburg
South Florida
Edward R. Brownell, Miami
John P. Goggin, Marathon

The address of the Society is 55 East Washington Street, Orlando, Florida.

Quebec Land Surveyors and ACSM Exchange Greetings

ACSM was represented at the Annual Meeting of the Quebec Land Surveyors' Association held at the Chateau Frontenac, Quebec, April 27–28, by President Lester C. Higbee and Gordon E. Ainsworth, Chairman of the Property Surveys Division. President Higbee gave two short talks which were well received by the many present, and Chairman Ainsworth presented a paper entitled "Some Land Surveying Problems in New England." At the banquet which highlighted the festivities, President Paul Savard paid glowing tribute to the ACSM and extended his official greeting to our organization. He was joined in this expression by Col. Charles C. Lindsay of Montreal and Dermot I. O'Gallagher of St. Foy.

The meeting was well attended by Association members and distinguished guests from neighboring provinces. During the course of the meeting an inspiring ceremony took place when seven new members were inducted as Quebec Land Surveyors and were presented their practitioner's certificates.

President Paul Savard, returned to office for his second term, stated in his speech of acceptance that the Quebec Association was keenly interested in becoming more closely affiliated with the ACSM. Much international as well as professional good will was engendered at this meeting. All present agreed that the U. S. and Canadian societies should intermingle to a greater extent than heretofore. With this thought uppermost nearly a dozen members of the Quebec Association expressed their desire to be present at the 1956 ACSM Meeting in Washington.

—Gordon E. Ainsworth
(Official Representative of ACSM at the Quebec Meeting)

Commonwealth Survey Officers' Conference

The Commonwealth Survey Officers' Conference, a quadrennial gathering in which the surveyors from the member lands of the British Commonwealth of Nations discuss their progress and problems in matters of surveying and mapping, was held in the Department of Geography of Cambridge University from the 10th through the 24th of August 1955. The conference then transferred to the vicinity of London and continued on the 25th and 26th of August with visits to the principal surveying and mapping agencies.

Officials of the conference were Brigadier Martin Hotine, President; Mr. G. W. Henlen, Secretary; and Lt. Colonel G. J. Humphries, Technical Secretary. The notably smooth conduct of the conference reflected thorough planning by these officials.

Approximately two hundred and thirty representatives were present from about twenty-nine member lands of the British Commonwealth. In addition, represenatives were present from Holland, Belgium, France, the Irish Republic, and the United States of America. From the United States, the representatives were Colonel Gerald Fitzgerald of the Geological Survey; Colonel E. I. Pratt, Jr. from the Aeronautical Chart & Information Center; Harry L. Coggin of the Photographic and Survey Section of the Joint Chiefs of Staff; Donald A. Rice from the U. S. Coast and Geodetic Survey; Dr. G. Etzel Pearcy, Geographich Attache at the American Embassy in Paris; and David L. Mills of the Army Map Service.

Twenty-six technical papers were presented at the Cambridge sessions. The subject matter included progress reports on surveying and mapping, new developments in equipment and techniques, cadastral survey, and land registration. Also presented were papers on the education, training, and professional status of the surveyor, among them an interesting and comprehensive paper by Lt. Colonel Humphries, Deputy Director of Colonial Surveys, outlining the courses in surveying and allied subjects leading to the qualification of surveyors in many countries of the Commonwealth. Mr. Mills presented a paper describing the Army Map Service's field operations in cooperation with the survey departments of the Sudan, Uganda, and the Belgian Congo, in completing the triangulation of the Arc of the 30th Meridian in Africa.

A large exhibit of surveying instruments, equipment, and services of Commonwealth origin was on display in the Department of Georgraphy. The redesign of the small Tavistock theodolite was a matter of much interest to the delegates, and the new Thompson-Watts plotting machine attracted much attention and favorable comment.

Two characteristics of this conference appear particularly worthy of comment: First, the excellent planning and organization of the conference was apparent in the strict adherence to schedules, the smooth and efficient conduct of all business and technical sessions, and the continued high level of interest evinced by the delegates. Second, the arrangements whereby the delegates were quartered and fed in the colleges of the University contributed much to the comfort of the delegates and facilitated those personal contacts and informal discussions which are so pleasant and valuable a part of these conferences.

East Bay Council on Surveying and Mapping

On the evening of October 13, 1955, the East Bay Council on Surveying and Mapping held a meeting at the El Cerrito (California) City Hall.

Four more of a series of Technical Reports being prepared by the Technical Committee, under the chairmanship this year of Harry Shatto, were presented at the business session for review and consideration for adoption by the Council. These include: Technical Report No. 9, Map Scales; No. 17, A Base Map for the East Bay; No. 19 (revised), Secondary Monuments; and Section I of No. 23, An Introduction to the California Coordinate System.

Dr. Robert N. Colwell of the Division of Forestry, University of California, addressed the meeting on "Aerial Photo Interpretation in Mapping and Related Fields." Dr. Colwell, a well known specialist in the comparatively new science of photo interpretation which has been spectacularly useful in the exploration and evaluation of natural resources, gave the members an interesting and informative acquaintanceship with interpretation procedures and results and with both the potentialities and the limitations of these methods.

Texas Surveyors Association

From the second issue of their new journal *The Texas Surveyor,* we learn that the Texas Surveyors Association, having carried to a successful culmination their struggle for laws requiring registration of surveyors in that State, does not plan to rest on its laurels even though it can take justifiable pride in a job well done. In a letter to the members, which appears on page one, W. A. Rounds, President of the Association for 1956, states that "the year 1956 finds the Texas Surveyors Association with a new purpose—a new and broader aim. Recognition by the people of the registered surveyor is now a must for a participant of an old and honored profession. This recognition is the torch to be carried throughout the State."

The same issue carries a report of the annual meeting of the Association on October 10 in Austin, highlights of which were authorization, by petition, for a completely revised TSA constitution; introduction of a proposed code of ethics for the Association; initiation of a study leading to the adoption of a recommended schedule of minimum fees and salaries for land surveyors in Texas; and the introduction of new officers and directors for the Association.

The Fourth Annual Texas Surveyors Short Course, which followed on the next two days after the annual meeting, set a new attendance record with 241 registered. Eight papers were presented: A. T. Mullins, attorney for the Texas Land Office disclosed some interesting and heretofore unpublicized aspects of early land practices in that State; Alvis Vandygriff, attorney for TSA in the drafting of the surveyors bill, introduced the members of the Board of Registration and explained the provisions and intent of the Registration Act; Commander C. J. Merdinger of the U. S. Navy gave a comprehensive illustrated discussion of the history and development of surveying instruments; James C. Adams, surveyor, Clint Little, title company executive, and T. J. Cloud, land developer, participated in a panel discussion on problems of the city surveyor; Wayland Sanford, Dallas attorney, outlined the preparations a surveyor must make before he takes the witness chair in a land boundary suit and described in some detail the manner in which a surveyor must conduct himself in giving testimony; M. B. Grove of the Wild Instrument Co. demonstrated the technique of the use of the subtense bar with a precision theodolite; Staley Mims, Surveyor Registration Board member, discussed some desirable steps that a rural or small-town surveyor can take to enhance his professional stature with his clients; and Mike Mahoney, Austin City Planning Director, discussed the civic responsibilities of the land surveyor and his obligation to the public to make the best use of the land.

EDITOR'S NOTE.—Interested ACSM members may, so long as the supply lasts, obtain a book containing all eight papers by addressing William Shirriffs, Secretary-Treasurer, Texas Surveyors Association, General Land Office Bldg., Austin, Texas. The price is 50 cents each.

Alberta Land Surveyors' Association

In a letter to the Publications Committee of ACSM, J. H. Holloway, Secretary-Treasurer and Registrar of the Alberta [Canada] Land Surveyors' Association, informs us that the annual meeting of the Association is to be held in Edmonton on January 16 and 17, 1956, and that 50 or 60 of the 90-odd members are expected to attend. It is easy for us here in Washington to imagine that mid-January would be a good time for surveyors in that latitude to leave their work and hold a meeting; what is not so easy to understand is how 50 or 60 percent of the members in that far-flung province can travel to a conference through midwinter snows and drifts and ice.

Mr. Holloway states that the interests of the Association center mainly around property surveys and that, at the present time, most of the work of members consists of right-of-way and site surveys in connection with the extensive development of the oil industry which is now going on in Alberta, townsite subdivision surveys, and highway and public works surveys.

Wisconsin Society of Land Surveyors

Success has at last crowned the long-drawn-out efforts of the Wisconsin Society of Land Surveyors to obtain legislation on registration and regulation of land surveyors in the State of Wisconsin.

The act, which became effective on August 12, 1955, provides, briefly, that, after January 31, 1956, a person wishing to practice land surveying in Wisconsin or to use or advertise any title or description tending to convey the impression that he is a land surveyor must be the holder of a certificate of registration as a land surveyor or have been granted a permit to practice land surveying. The act sets forth education and experience requirements governing issuance of certificates, fees for registration, penalties for violation, certain exemptions, and designates the Engineering Division of the Wisconsin Registration Board of Architects and Professional Engineers as the administering body.

A great deal of the credit for the successful culmination of long years of work toward this legislation belongs to the Wisconsin Society and in particular to its Legislative Committee under the chairmanship of Robert J. Poss.

Massachusetts Land Surveyors Elect

At the annual meeting of the Board of Directors of the Massachusetts Association of Land Surveyors and Civil Engineers, held at Grafton on May 14th, the incumbent slate of officers was returned to office for a second term as follows: President, Gordon E. Ainsworth, Deerfield; Vice President, Adolph Kohlhofer, Pittsfield; Secretary, Llewellyn T. Schofield, Hollliston; and Treasurer, Newell B. Snow, Buzzards Bay. Recently the Association voted unanimously to affiliate with ACSM and to hold a two-day annual meeting in Boston early in December.

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CONGRESS NEWS

Election of Officers for 1956

Under the provisions of ACSM Constitution and Bylaws, on September 8, 1955, President Higbee appointed the following ACSM Nominating Committee; Frank S. Borden (elected chairman), Robert H. Lyddan, Lansing G. Simmons, and member ex officio Walter S. Dix —secretary to the committee. Following its meeting of September 21, 1955, the ACSM Nominating Committee does hereby present and introduce the following candidates accepting nomination and responsibility of office if elected by ballot of the membership for the coming year:

For President (one year term) *renominated:*
LESTER C. HIGBEE, Troy, N. Y.
For Vice President, (one year term):
G. W. HERZOG, Houston, Tex.
Director for one year (1956) to fill past-president's constitutional directorship: Incumbent Vice President:
WILLIAM C. WATTLES, Glendale, Calif.
For Directors, 1956–57 (Five to be elected for two-year terms:
Bro. B. AUSTIN BARRY, Riverdale, N. Y.
J. C. CARPENTER, New York, N. Y.
S. P. CHAPMAN, SR., New Orleans, La.
KENNETH S. CURTIS, Lafayette, Ind.
ROBERT O. DAVIS, Denver, Colo.
EDWARD B. ESPENSHADE, Evanston, Ill.
VICTOR H. GHENT, Annandale, Va.

Ballots are scheduled to be mailed to the membership during the final quarter of 1955 so that election results may be announced as early as possible in the new year. Actual induction of new officers will take effect during the 16th Annual Meeting in March 1956, the incumbent officers remaining in office until that time.

Brief biographies of the candidates follow:

LESTER C. HIGBEE

Lester C. Higbee was born in Atlantic City, N. J., where he received his early schooling. He earned his degree in Civil Engineering from Rensselaer Polytechnic Institute in 1912 and was engaged in field and office engineering of bridges and hydroelectric plants until 1915, when he became research and development engineer and sales director for the W. & L. E. Gurley company in the engineering and surveying instruments field. He is now President of the Gurley company. He is a New York State licensed professional engineer. He is a Silver Star and Purple Heart veteran of World War I, in which he was a machine-gun company commander. Until retiring in 1953 he was Brigadier General in the New York State Guard. An untiring supporter of ACSM since its charter, "Hig" is a past-chairman of ACSM Instruments Division. He presided at the formative meetings of the Texas Section of ACSM in Houston in 1950 and the Louisiana Section of ACSM in New Orleans in 1954. Elected President of ACSM in 1955, he has travelled extensively to represent the American Congress on Surveying and Mapping at the Canadian Institute of Surveying and Photogrammetry meeting in Ottawa, Canada; the Pan American Consultations on Cartography in Mexico City; and has visited widely in the United States with ACSM local Sections and Affiliates.

G. W. HERZOG

G. W. Herzog, a pioneer in the use of aerial surveys in the southwest, had his scholastic training interrupted by World War I, but prior thereto and sometime thereafter completed his education, which included two years of college at Kansas State, ten months in Paris University, France, and numerous correspondence courses. After serving with several major oil companies, he became connected with the Shell Oil Company, having risen from an assignment in the geophysical division to that of Chief Civil Engineer in charge of surveys, drafting, and reproduction. He established standards for the drafting and surveying sections, which are now the basis for promotion. He collaborated with the Tobin Company of San Antonio in devising a precise method of making ownership maps with the use of aerial grids which resulted in the compiling of the first accurate property maps of southern Louisiana. He also devised a system whereby aerial pictures became a necessary part of all land survey work done by the Shell Oil Company. He is the author of numerous papers

on mapping and surveying. He lists flying as among his special interests. He holds a private license, has 1600 hours to his credit, and still flys regularly. Active in the organization of the Texas Section of ACSM, he was elected its first chairman. He has served ACSM as a Director. He is also a member of the Society of American Military Engineers and the American Society of Photogrammetry. He makes his home in Houston, Tex.

WILLIAM C. WATTLES

Though a native of Kansas, William C. Wattles has been a resident of California for the past 49 years. He received his EM degree in 1903 at the Colorado School of Mines.

He is a Licensed Land Surveyor and Registered Civil Engineer of California, specializing in land and title location. For 10 years he was with the Los Angeles County Surveyor, Flood Control, and Road Development offices as Chief of Party, Office Engineer, and Deputy. For 31 years he was associated with the Title Insurance and Trust Co., Los Angeles, as Field Engineer, Title Engineer, and Chief Engineer. He is an author and lecturer on land location, title location, property descriptions, and allied subjects.

Mr. Wattles is a member of the American Right of Way Association. He has been a member of ACSM for 13 years and has served as Chairman of the Technical Standards Committee, Chairman of the Property Surveys Division, member of the Advisory Council, Director, and as Vice President, in which office he now serves his second term.

Bro. B. AUSTIN BARRY

Brother B. Austin Barry received the A.B. degree from Catholic University in 1937 and the B.C.E. degree from Rensselaer Polytechnic Institute in 1942. At the latter institution he was awarded the MacDonald Prize in Civil Engineering. He received the M.C.E. degree from New York University in 1949. Since 1943 he has taught at Manhattan College, where he is now Assistant Professor of Civil Engineering in charge of surveying.

He is an Associate Member of the American Society of Civil Engineers. In 1949 and 1950 he was a Director of the Metropolitan Section of A.S.C.E., and is now serving as Chairman of the Task Committee on Status of Surveying and Mapping in the Division of Surveying and Mapping of A.S.C.E.

Bro. Austin was a member of the Executive Committee on Surveying and Mapping of the American Society for Engineering Education during 1949–51 and Chairman of that Committee in 1951–52. In 1952 he conducted the Third National Surveying-Teachers' Conference at Blackduck, Minn. Presently he is finishing his term as President of the Metropolitan New York Section of the American Society of Photogrammetry. He is a member of Sigma Xi, Chi Epsilon, and the Society of American Military Engineers. He holds a Professional Engineering license.

He has been active in ACSM since 1947, having served during the past three years as a Director of the Education Division and as its Chairman during the past year.

J. C. CARPENTER

J. C. Carpenter, of Watertown, S. Dak., started surveying under his father's supervision during his grade-school days and was a Deputy State Surveyor in 1903. The firm of Carpenter and Son resurveyed 2700 square miles of eastern South Dakota. Before leaving home in 1910, after graduation from Iowa State College with the degree of B.C.E. in 1909, Jack had two years of railway location and construction, had been county surveyor of three counties, planned and supervised construction of several large drainage projects, and acted as City Engineer of Watertown.

From 1910 to 1917 he was a Drainage Engineer, U.S.D.A.; District Engineer, Philippine Bureau of Public Works, and Minnesota and California Highway Departments; and Valuation Engineer, California office of the I.C.C. for Railway Valuation. Entering the Bureau of Public Roads as a Drainage Engineer in 1917, he soon transferred to the highway division and served as District Engineer in North Carolina, Virginia, Arkansas, Louisiana, Oklahoma, Texas, and Puerto Rico. In 1946 he was assigned as a supervising Research Engineer in the Highway Transport Branch of the Washington office of the Bureau.

Jack retired from the Federal service in 1953 and has since been associated with the consulting engineering firm of Coverdale and Colpitts, with headquarters in New York City. As Senior Traffic Engineer, he has supervised traffic surveys in Florida, Connecticut, Cuba, Louisiana, Kansas City, and for the Kansas Turnpike Authority on the original turnpike and extensions. He is a registered Professional Engineer in Kansas.

With George Syme of North Carolina, Mr. Carpenter advocated the use of plane coordinate systems as an aid in the development of accurate survey practice. North Carolina's State Standard System was the first to be approved, and the Texas system which Jack promoted was established soon afterward. He has been an active member of ACSM since its organization and was chairman of the Committee on Highway Surveys which developed the "Standards of Accuracy for Highway Surveys" and inaugurated the campaign for "Topographic Mapping along the National System of Interstate Highways." Jack was chairman of the committee on Highway and Bridge Surveys of the A.S.C.E. for 12 years.

Mr. Carpenter is a member of the American Society of Photogrammetry, the Institute of Traffic Engineers, and a life member of the American Society of Civil Engineers.

S. P. CHAPMAN, SR.

S. P. Chapman, Sr., was born in Dallas County, Texas. Educated, through high school at Ferris, Tex., and later at Texas A. & M. College, he began his professional career in 1925 with the Dallas Power and Light Company. Since 1928 he has been with the Shell Oil Company in various field and office civil engineering capacities concerned with various phases of surveying and mapping. At present he is Superintendent of the New Orleans Area of the Shell Oil Company's Central Surveying and Mapping Division and responsible for operations in the States of Louisiana, Arkansas, Mississippi, Georgia, and Florida. Active in forming the Louisiana Section of ACSM at New Orleans, he was its charter chairman, which term has just ended.

KENNETH S. CURTIS

Kenneth S. Curtis was born in Indiana and received his education in civil engineering from Purdue University, receiving both the B.S. (1946) and M.S. degrees. He has always considered his specialization as surveying and mapping, has taught these subjects at Purdue during the past nine years, and has attained the rank of Assistant Professor. He has taught courses in plane, route, topographic, hydrographic, geodetic, and photogrammetric surveying and cartography, both on campus and at summer surveying camp. He has authored several articles on these topics.

His experience also includes a season's work aboard the U.S.C. & G.S. Ship *Explorer* in Alaskan waters; work with Jack Ammann Photogrammetric Engineers of San Antonio, Tex.; work with geodetic triangulation and leveling parties of the U.S.C. & G.S. in Indiana and New York; and many surveying and mapping projects of lesser magnitude.

Mr. Curtis has been an active member of the American Society of Civil Engineers since 1946, American Congress on Surveying and Mapping since 1947, American Society of Photogrammetry since 1947, American Society for Engineering Education since 1948, and the Society of American Military Engineers. He is now chairman, Visual Aids Committee, Education Division, ACSM; is executive secretary of the Indiana Society of Professional Land Surveyors; and has worked with the Indiana Topographic Mapping Committee which has recently started on a ten-year completion program.

He is living at Happy Hollow Road, R. R. No. 1, Lafayette, Ind.

ROBERT O. DAVIS

Robert O. Davis graduated from Ohio State University in 1930, with a degree in civil engineering. He is registered both as Professional Engineer and Surveyor in Ohio. He has been an engineer with the Topographic Division of the U. S. Geological Survey from 1930 until the present time, except for service with the Air Force from 1942 to 1946. During World War II he served with the Aeronautical Chart Services in the chart plant at St. Louis and with the 6th Photo Squadron at Jefferson Barracks, Mo.

For the past nine years he has been Rocky Mountain Region Engineer for the Topographic Division of the U.S.G.S., with headquarters at Denver, Colo., and has directed the work of the Topographic Division in the Rocky Mountain States and in the Territory of Alaska. He is a member of the American Society of Photogrammetry and the American Society of Civil Engineers.

EDWARD B. ESPENSHADE, JR.

Dr. Edward B. Espenshade, Jr., is professor of geography at Northwestern University. He spent five years as Curator of Maps, developing a research map collection for the University of Chicago, where he also taught for four years. He acted as Foreign Map Editor with the Army Map Service 1942–44 and served a year overseas on mapping problems with Engineer Intelligence 1944–45. Since that time he has been teaching cartography at Northwestern

University. He edits Goode's World Atlas and acts as cartographic consultant to Rand McNally & Company.

VICTOR H. GHENT

Victor H. Ghent, of Annandale, Va., is a Professional Engineer and Land Surveyor practising in general land surveying, land planning, and engineering. He received his education from Baltimore Polytechnical Institute, Johns Hopkins University, and I.C.S. He was a United States Army instructor, 1943–46. Offices which he has held in the recent past include: Secretary-Treasurer, Virginia Association of Surveyors (3 years); charter President, Northern Virginia Chapter, V.A.S.; President, Annandale Businessmen Association; Cabinet Secretary-Treasurer, Lions District 24 C; Secretary-Treasurer, Annandale Lions (4 years); and Corresponding Secretary, Property Surveys Division, ACSM. He is a charter member of the Virginia Society of Professional Engineers and a member of the Alpha Chi Ro fraternity. Vic is currently serving as President, Annandale Lions and Secretary-Treasurer, Property Surveys Division, ACSM.

Texas Passes Law Requiring Licensing of Public Land Surveyors

The following message has been sent to all members of the Texas Section, ACSM:

"You will be pleased to learn that the bill requiring the licensing of public land surveyors, performing boundary surveys, has been passed by both the House of Representatives and Senate and was signed by Governor Shivers on April 29th.

"This newly passed law provides that the governor shall have ninety days in which to appoint a six-man board to administer the law, pass on applicants, etc. After the board has been appointed, thirty days are to be allowed for the appointment of a chairman for the board, and the performance of other duties necessary for the proper administration of the act.

"I feel that we all owe a very generous vote of thanks to those individuals who have given so unselfishly of their time and efforts to help put this law through. I believe that a special vote of thanks is due: Ed Morse, Fred Williamson, and W. H. Wilson for their outstanding efforts"

—R. L. SARGENT
Chairman, Texas Section

Northern California Section

About 100 members and friends of the Northern California Section attended a Field Night on June 24, 1955, at the Richmond Civic Center. Interest is evidenced by some coming from as far as Carmel, 130 miles southwest; Modesto, 105 miles east; Santa Rosa, 85 miles northwest; and Redding, 220 miles northeast.

Norman Sylar, Geodetic Engineer with the USC&GS, opened the program by describing the demonstrations, with the aid of a portable microphone. Engineers from the City of Oakland, under the direction of Wendell Daily, demonstrated precise taping with an invar tape. The Zeis self-leveling level was demonstrated by Roy Nakadegawa of the City of Richmond. The A. Leitz Co. furnished a subtense bar which was demonstrated by Al Milano of Contra Costa County. Although inexperienced in its operation, Al's first observation was verified within 0.03 foot by a steel-tape measuremnt of the 100-foot course. Engineers from the East Bay Municipal Utility District, under the direction of Joe Dolan, demonstrated angle observation with a direction theodolite, using their specially constructed lights which included a novel neon tube found to be excellent for use in the bay area.

This part of the program was followed by an inspection of the equipment used in the demonstrations and the exhibits of the commercial distributors. At 9 p.m. the Chairman convened the meeting in the Library Auditorium and announced the coming meetings and election. An ovation of thanks was given Jim Godman for organizing the evening's program. Hans Wahlen discussed triangulation computations by analytical methods, explaining the method in detail. The very enjoyable motion picture on the manufacture of Wild theodolites was then shown, through the courtesy of Surveyors Service Company.

—C. A. WOOLDRIDGE, JR.
Chairman

Northern California Section Visits Friden Plant

On April 29, 1955, the members of the Northern California Section of the Congress were the guests of Friden Calculating Machine Co. at its San Leandro plant, a few miles south of Oakland, California. The meeting started in mid-afternoon and lasted until 10:30 in the evening. Approximately 50 members were present and these were conducted through the plant in small groups, each accompanied by a guide. The tour was quite complete and considerable interest was evidenced in the fact that all phases of the manufacture, from cutting and stamping of the many parts, through the machining and finishing, the assembly and testing, and preparation for shipment are accomplished on the premises. The novel method of casting the machine keys in two steps, first forming the black blanks with voids for the figures, then filling the voids with a light-colored plastic drew considerable attention as did the use of the 10-key multiplier keyboard unit of the calculator as the basic unit of an adding machine recently included in the company's line of products.

The Friden Company was host for cocktails and an excellent dinner served at the Villa Lorenzo at the end of the inspection tour.

The meeting reconvened at the plant about 7:30 p.m., and Robert C. Gleichman, Friden Educational Research Manager, and a group of assistants tutored the guests in special methods of solving problems commonly encountered by surveyors. One calculator was available for each two guests and provided the opportunity for each man to fully investigate and understand the abbreviated problem methods applicable on this type of calculator. One model of the calculator will automatically extract the square root of a number placed in the keyboard when the operator selects and depresses the key indicating the decimal point.

Mr. Gleichman handled arrangements for the Friden Company; and J. R. Godman, Chief Surveyor for the East Bay Municipal Utility District, completed details for the Northern California Section of the ACSM.

AT THE EVENING SESSION MR. GLEICHMAN INSTRUCTED MEMBERS OF THE SECTION IN THE APPLICATION OF THE CALCULATOR TO SURVEYING COMPUTATIONS

Personals

President Lester C. Higbee, representing ACSM, presented greetings to the Pan American Institute of Geography and History, to the Sixth Assembly, and to the Seventh Consultation on Cartography, held in Mexico City during August.

Gordon E. Ainsworth, of Massachusetts, chairman of ACSM's Property Surveys Division, has been nominated by President Higbee to represent ACSM at the February 1956 annual meeting of the Canadian Institute of Surveying and Photogrammetry, to be held in Ottawa.

Colorado Section

The Rocky Mountain Section of the American Society of Photogrammetry and the Colorado Section of ACSM held a joint meeting on October 5, 1955, at the Denver Federal Center to discuss a cooperative action toward a concurrent or joint sectional meeting to be held in Denver, September 30 through October 2, 1956, the time proposed for ASP's semi-annual meeting in that area. With many in the Denver area active members of both the ASP and ACSM local sections, it was felt on both sides that a combined convention would be more practicable and successful, and both sections have requested sanction of the proposal from their respective organizations.

In the meeting held among the officers of both groups, Stanley M. Borrell was elected general chairman for the convention and J. E. Mundine and J. J. Tanner were elected assistant chairmen. All three are members of both organizations. A later meeting will be held to determine the various other committees and to appoint their chairmen.

—M. H. Zalewski
Section Editor

(Editor's Note.—ACSM officially approved the joint sectional proposal in executive session on October 7, 1955. The ASP Board has also approved the proposal.)

Southern California Section

Nearly two hundred members and guests of the Southern California Section of ACSM were on hand in the General Petroleum auditorium in Los Angeles when William C. Meek, Chairman of the section, called the fall meeting to order on October 28.

S. B. Barnes, Los Angeles structural engineer and member of the State Board of Registration for Civil and Professional Engineers and Land Surveyors, was introduced by Chairman Meek. He in turn introduced J. Douglas Locke, Executive Secretary for the Board.

Mr. Locke discussed the Board's history, makeup, and operations, and gave the members some appreciation of the many problems with which it contends, considering that California has about one-third of the registered engineers in the United States.

An outline of current and proposed legislation affecting land surveyors and civil engineers preceded a lively question and answer period.

—Tom R. Humes
Section Editor

Texas Section Holds Fall Meeting

The Texas Section of ACSM held its 1955 Fall Meeting on October 27th at the Armadillo Club, Houston, Texas. Some 145 members and guests were present. Some came from Wharton, Angleton, Fort Worth, Freeport, Alvin, and other points outside of Houston. A refreshment period and barbecue preceded the program.

J. Stuart Boyles, of Houston, engineer-surveyor who helped draft and promote the newly enacted Public Surveyors Registration Act, spoke on "Problems Concerning the Registration of Public Surveyors." He is a member of the State board of registration for surveyors.

W. A. Rounds, Regional Engineer, Continental Oil Company, Fort Worth, and newly elected President of the Texas Surveyors Association, spoke on "The Professional Status of the Texas Land Surveyor." G. W. (Buck) Herzog, Chairman of the Program Committee, said, in introducing Mr. Rounds, that, at the meeting of the parent organization in Washington this spring, the emphasis was placed upon "The surveyor must regain prestige and recognition."

Mr. Rounds said some of the qualifications for a good surveyor were conditioned upon his liking for the out-of-doors in all kinds of weather, his educations and experience, his study of information outside his textbooks, and his professional status. He further stated that a surveyor's professional status was determined by the manner in which he served the public. As a servant to the public he becomes a professional man provided he includes ethics in his services.

Mr. Rounds paid tribute to E. D. Morse, Houston, a former Chairman of the Texas Section and a former President of the Texas Surveyors Association. He said that "Ed" Morse is the man who has done most for surveying in 1955.

R. L. Sargent, Chairman of the Texas Section, announced that its Annual Meeting would be held at the Armadillo Club on December 8th—with a turkey dinner.

W. J. Warren, Treasurer, reported a balance of $444.34 as of October 27, 1955. He reported 225 members in the Texas Section, including 179 paid-up members.

—Forrest Daniell
Director, Texas Section

Louisiana Section

The third quarterly meeting of the Louisiana Section of ACSM was held on September 21, 1955, in the Engineers' Club, De Soto Hotel, in New Orleans.

Before the session began, an informal "acquaintance hour" was held for visitors and new members.

Section Chairman Jack Toler revealed plans for a cocktail party to be held in December with members and wives invited. The next quarterly meeting was set for December 5.

S. P. Chapman, last year's Section Chairman, introduced Mrs. Ellen Bryan Moore, Register of State Land Office, Baton Rouge. Mrs. Moore gave a very interesting talk on the activities of the State Land Office which included a short history and an outline of the organization of the State Land Office.

Mr. Chapman then introduced R. G. Watts of the Magnolia Petroleum Co., Dallas, Texas, who gave an illustrated talk on offshore surveying problems encountered in making well locations and establishing control for surveys in the Gulf of Mexico. Color slides, illustrating the various phases of offshore work, were shown. Mr. Watts expressed his gratitude to the Coast and Geodetic Survey for their help in establishing base lines for the surveys.

—Robert Baker, Jr.
Section Editor

President Higbee Visits Local Sections

During the late weeks of the past summer, President Higbee toured the Western United States, visiting first with the King County Surveyors Association, ACSM affiliates of Seattle, Washington. On Labor Day he attended a luncheon meeting with some of the ACSM Southern California Section members at the Los Angeles Engineers Club. Then he moved to San Francisco for an evening meeting with members of the Northern California Section of ACSM at the U. S. Engineer's offices. He then turned eastward to Denver where he met with the ASCM Colorado Section and some of the American Society of Photogrammetry Rocky Mountain Section members, at which time the proposed Denver joint-sections meeting was discussed and given presidential encouragement.

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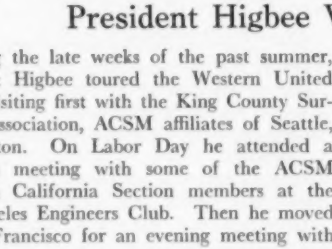

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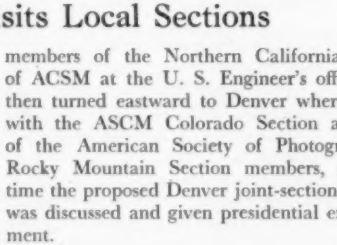

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ANDERSON, Monte, 8552 S. Greenvale St., Rivera, Calif.—Sales Representative, Surveyors Service Company

BASS, Geoffrey H., 30 Main St., East Hampton, Long Island, N. Y.—Land Surveyor and Village Engineer
BEATTY, Allen, 204 Union Station, Houston, Tex.—Assistant Engineer, Missouri Pacific Lines
BECKMAN, Mrs. Natalie S., 4915 Berryman Ave., Culver City, Calif.—Cartographer, Capital Company, 649 S. Olive St., Los Angeles 13, Calif.
BOOKER, B. W., 150 Oak St., San Francisco, Calif.—Assistant State Highway Engineer
BROOKS, L. Ray, Drafting-Surveying Division, Shell Oil Co., Box 193, New Orleans 22, La.—Draftsman
BROWN, Curtis M., 5075 Keeney St., La Mesa, Calif.—Partner, Daniels, Brown and Hall, Surveyors and Engineers
BROWN, Thomas B., Jr., Shell Oil Co., 925 Common St., New Orleans, La.—Head Draftsman, Production Dept.
BROWNSTEN, Samuel E., Court House, Crown Point, Ind.—County Surveyor, Lake County
BRUNTY, Clarence E., 7216 Halray Ave., Whittier, Calif.—Office Engineer, Survey Division, Los Angeles County Eng neer
BURLINGAME, G. M., Title Insurance Corporation of Pennsylvania, Lancaster Ave., Bryn Mawr, Pa.—President

CROWDER, George A., City Building, Columbus, Ind.—City Engineer

DANIELS, Ralph E., Box 1278, Marfa, Tex.—Consulting Engineer, Lodal and Associates
DIPPY, Robert N., 31 Beechwood Road, Media, Pa.—Engineer
DOWNS, Donald R., 206 Justin St., Shreveport, La.—Civil Engineer, Gulf Refining Co.

FERICY, Richard, 611 Second St., Dunellen, N. J.—Surveyor, Hydrographic Survey Group
FONES, Wallace, 2405 San Jacinto St., Houston, Tex.—Partner, A. C. Stimson Land Surveying Co.
FORTIN, Comdr. Henry O., Coast and Geodetic Survey, Box 3887, Honolulu, T. H.—Honolulu District Officer
FRANK, Fernando L., 1014 Milan St., New Orleans 15, La.—Topographic Draftsman, Shell Oil Co.

GIEROW, Albert O., 2240 Maple Drive, Jackson, Mich.—Engineer, Commonwealth Associates, Inc.
GRIMES, Prof. John S., 6220 Lawrence Drive, Indianapolis, Ind.—Professor of Law, Indiana University Law School

HALLIDAY, G. H., Box 8099, Causeway, Salisbury, South Rhodesia, Africa—Professional Assisant
HARRISON, Shannon, Shell Oil Co., P.O. Box 1748, Baton Rouge, La.—Fieldman
HAUCK, Richard E., 273 San Gabriel Court, Sierra Madre, Calif.—Instrumentman, Los Angeles County Road Dept.
HAYNIE, Alton A., Box 2516, Dhahran, Saudi Arabia—Surveyor, Arabian-American Oil Co.
HENRY, William T., 1321 Slade Run Drive, Falls Church, Va.—Civil Engineer, Holland Engineering Co.
HOFER, A. K., 301–4 Dime Bank Bldg., Fort Wayne, Ind.—Civil Engineer

JONES, Margie Ann, 399 North 25th St., Camp Hill, Pa.
JONES, Robert E., 8 2nd South Shores Drive, Decatur, Ill.—Drafstman, Civil Engineering Dept., A. E. Staley Mfg. Co.

KENNEDY, G. H. C., Department of Lands, Box 293-A, G.P.O., Adelaide, S. Australia—Chief Topographical Surveyor
KRULL, Robert A., 1041 W. 3rd St., Hobart, Ind.—Krull and Son, Civil Engineers and Surveyors

LANE, Benjamin B., Jr., ACIC, 2nd and Arsenal Sts., St. Louis 18, Mo.—Chief, Technical Planning Division
LANFEAR, Alfred J., 8 Birch Lane, Glen Falls, N. Y.—Senior Highway Engineer, Washington County Highway Dept.
LASLOW, Joseph, 4223 Henry Ave., Hammond, Ind.—Party Chief, Rubright-Fabian Engineers, Inc.
LENON, Robert, Lenon Engineering Offices, McKeown Ave., Patagonia, Ariz.
LEWIS, Robert T., 271 S. Hemlock St., Ventura, Calif.—Surveyor, Lewis and Lewis
LINDH, Wm. J., 2048 La France Ave., South Pasadena, Calif.—Civil Engineer, Designer Braun Engineering Co.
LIPPMAN, Robert L., 7961 Birch Drive, Hammond, Ind.—City Engineer
LISTER, Lee H., 311 Cecil Ave., Buchanan, Mich.—Clyde E. Williams and Associates
LUBBERS, Lawrence, Jr., R.F.D. 3, Box 1239-E, Annapolis, Md.—Cartographer, U. S. Navy Hydrographic Office

MADDOX, Sterling R., 8506 Dixon Ave., Silver Spring, Md.—Maddox and Hopkins, Engineers and Surveyors
MARCHAND, Blanchard J., P.O. Box 305, Cottonport, La.—Land Surveyor
MARCHER, Leland R., c/o Aramco, Dhahran, Saudi Arabia—Surveyor, Arabian-American Oil Co.
MARTIN, Robert L., 821 N. McCann St., Kokomo, Ind.—Engineer, Holtz Construction Co.
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This illustrated pamphlet is National Bureau of Standards Circular 565 (issued August 26, 1955) and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is 30 cents per copy.

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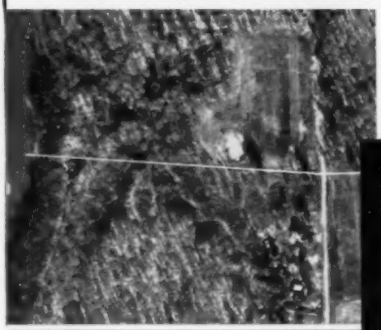

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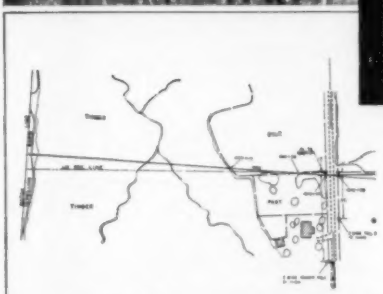

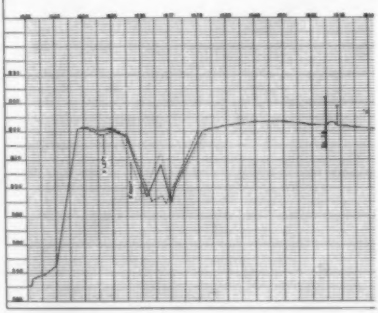

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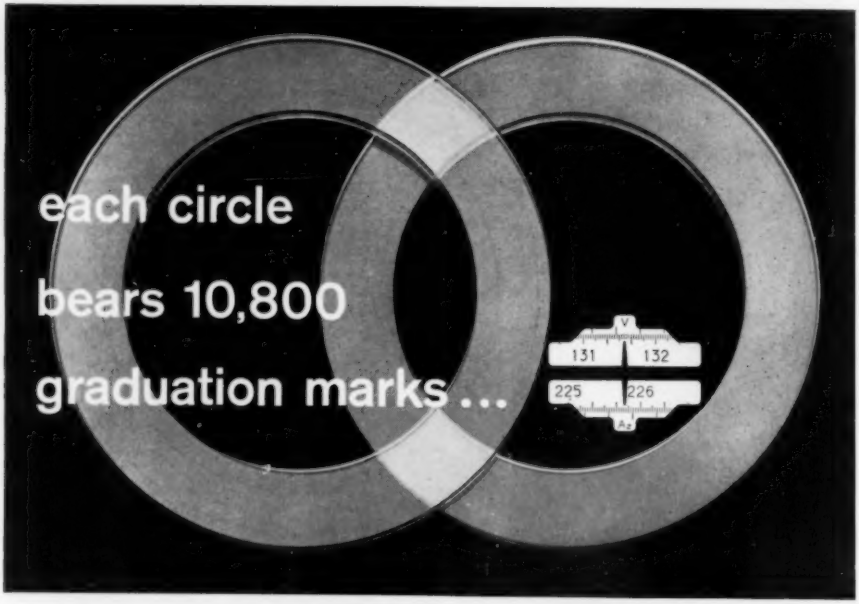

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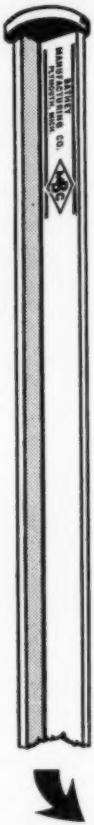

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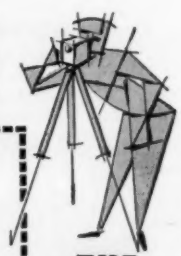

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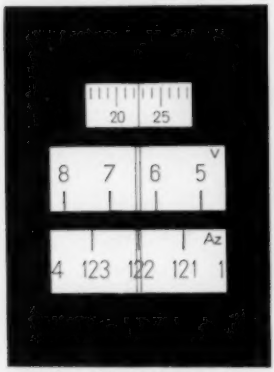

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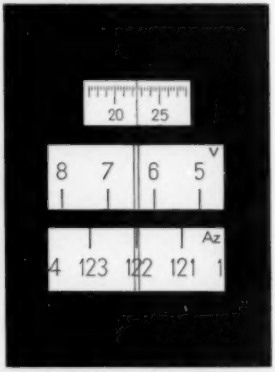

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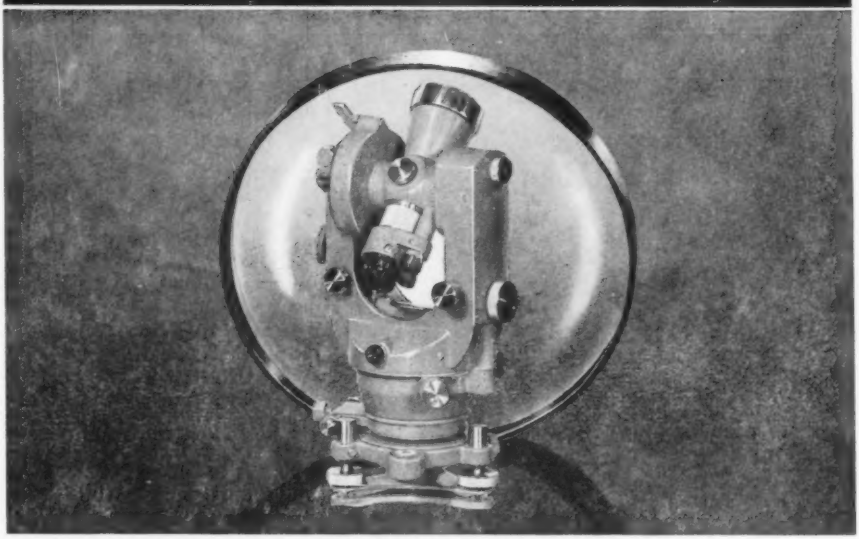

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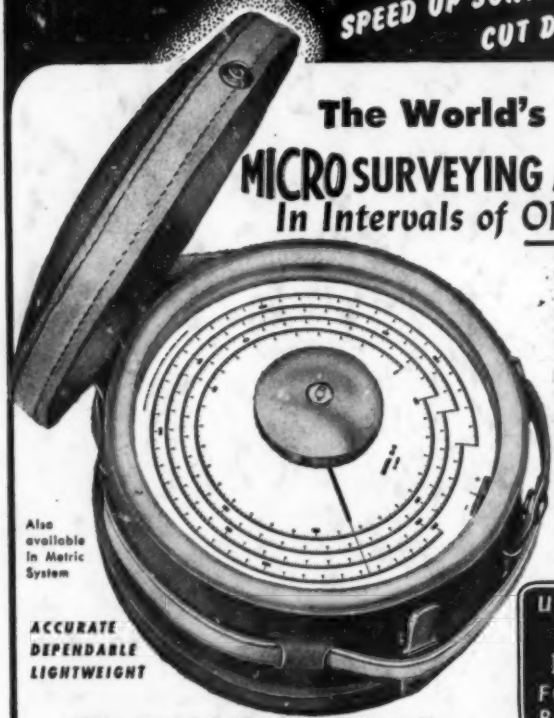

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